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THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

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PUBLISHERS' STATEMENT.

No person, firm, or corporation, interested directly or indirectly in the production or sale of building materials of any sort, has any connections, editorial or proprietary, with this publication.

THE BRICKBUILDER is published the 25th of each month.

IN our efforts to bring to the attention of the manufacturers of brick the ideas of some of our leading architects relative to the kind of brick for which there will be demand; at the same time pointing out some of the defects which unquestionably exist in a large percentage of the product now being put upon the market, we feel that we shall be performing needed service within the limitations of our field.

It is our purpose to watch carefully the best interests of the industries which we represent, and we know of no more effectual way of establishing a thorough understanding and friendly relationship between the architect and manufacturer than by an open and fair interchange of views.

Below we publish the third letter on Colored Bricks.

IT is rather interesting, in studying the architectural productions of the last ten or fifteen years in this country, to notice that brick, which is one of the oldest manufacturing building products that we know of, should be the prime vehicle in the elaboration of an entirely new departure in building methods. A twenty-story steel-framed building can, of course, be built with facings of stone, but it is pretty generally admitted that the best material to use for encasing the steel skeleton is burnt clay in some of its various modifications. The new movement in architecture marks what might fairly be called a Brick Era, and never before has the architect been offered so wide a selection in both brick and terra-cotta. Starting with the plain red, we have worked through all the colors of the rainbow, including both black and white; and, with such a variety of possible treatments, the wonder is not that we have so many instances of misapplied terra-cottas and colored bricks, but, rather, that the failures are not a thousand times worse than they are.

We all admire the old brickwork of Italy, Spain, and the Rhine provinces, and our architectural students will go miles out of their way to see walls constructed of materials which, perhaps, our modern manufacturers — fortunately, not all of them — would scorn as crooked, badly burnt, or uneven in color, but which in place owe a considerable element of charm to the very irregularities of mold or burn to which we might object in a modern product. It is undoubtedly true that the success of the old builders was due less to deliberate intent than to the fact that in those days they had no wide range of color or quality, and could not depart very far from a safe treatment of their surfaces. A brick was a brick, neither pressed, water struck, sprayed, nor enameled, but just a plain brick. Fortunately, it was also a good brick, and, though there was not a great deal of variety as compared from brick to brick, the process of manufacture by hand gave a variety of tone which resulted in beautiful wall textures. We approximate those effects still with our common brick, but somehow we have totally failed to touch such results with our better qualities. There comes to mind at this moment a building in Boston, on a prominent street corner, which is faced with a very carefully selected brick. The building rises considerably above its neighbors, and the party wall which is exposed to view from the street is faced up with an ordinary, hard-burned brick. The result, however, is that the unstudied, common brick wall has a beautiful, tender pink tone, while the face brick, which was intended to be much more ambitious, loses itself as a wall texture. In the old days they went it blind with their brick, and by simply following good precedent accomplished results which are sometimes the despair of our modern artists. But we, in this omniverous nineteenth century, have eaten of the tree of knowledge, and we cannot build our brick walls in the simple customs of our forefathers. We must select, we must endeavor to analyze in advance, and in theory, at least, we should try to predicate results. It is sometimes difficult to make an obdurate client, or we may say even a successful manufacturer, appreciate an architect's feeling about a brick wall. Those who study the possibilities from an artistic standpoint readily appreciate that texture is sought far oftener than color, and that the surface of the brick, or even the particular pigment used in coloring matter, really counts for less than the final appearance of brickwork when laid up in joints. Judging by many of the samples which are put upon the market, it would seem as if the manufacturers work from a small sample brick up to a wall color, rather than from a wall surface down to an individual brick, and the difference is a very marked one in its results. Half a dozen shades of brick which might tone beautifully when placed side by side on a drawing table would either fade into nothingness or be hideously glaring when put together in large masses on a wall. And the only sure way to determine how the bricks are to look in a building is to build a wall of them and look at it under various conditions of the weather.

One difficulty with modern brickwork is that it is no longer wholly a constructive material, but is treated too largely in a decorative sense, much as terra-cotta itself, which is rightfully as truly a constructive material as brick, and which is still used in a constructive sense for our floors and partitions, but for external application has

come to be nothing but the veriest film of veneer on the outside of a rough brick wall. If face brick were made less carefully, perhaps, but more thoroughly, and with a better appreciation of tones, our brickwork would show more logical and more interesting results and the coarser material would have even a better hold on the public appreciation than it does now as compared with stone. The immensely widened possibilities in color which the modern brick manufacturers have placed at the disposal of the architect have not been accompanied by a corresponding increase in the quality of the work. One can go through the market to-day and, aside from the output of a very few kilns, it is safe to say that nine tenths of the bricks that are manufactured and put on the market are not fit to use in a building which is calculated to last more than a couple of generations. There are plenty of instances of brickwork which has looked to be all right, but which the slow action of time has corroded in a few years to such a point that the brick was practically worthless. The brick manufacturers are not alone to blame for this result. They have simply met the demand for a fine-looking but inexpensive product. Every architect knows the difficulty of getting good first quality brick delivered at the building, and if the manufacturers would follow the notable examples set by a very few of the brick firms, and would concentrate their energies upon turning out good bricks, rather than necessarily a great variety of colors, the color of brickwork itself would by a process of natural selection resolve itself into the tones which are most pleasant and the colors which are most satisfactory for general use. There is no manufactured architectural product into which so much pure caprice has entered as in the production of the so-called fancy bricks. Some of them have done a good work. More of them are absolutely worthless, and the majority of them have been poorly made and are treacherous material for an architect to depend upon. This country is still so young, or at least has so few buildings which have stood for generations, that we are sometimes oblivious to the perishable quality of the materials used about us, and we build so truly for to-day that the possibility that our buildings may not outlast half a century troubles us very little. There are really only three materials at our disposal which are perfectly reliable for external wall construction; namely, the best selected granites, one or two grades of southern marble, and burnt clay in its various forms. While the advantages are strongly in favor of the latter, it behooves the manufacturer to keep up the standard and to let none but the best leave his yard.

But there are bricks and bricks. Perhaps we ought not to blame the manufacturer at all, but say the poor quality of bricks is more truly due to the ignorance of the architects in allowing themselves to be so easily imposed upon. But when the time comes that our manufacturers will cease studying their samples and will work back from the brick wall, we will have far less trouble in determining just what shades to use in a certain place in order to produce certain results, and brick can then take on an artistic value which now comes only from most diligent seeking and experimenting on the part of the architect. — C. H. B.

WILL the parties who submitted the drawings in the City House Competition marked "Penciler" and "N. H." (combined) send us their address, as the envelopes containing same have been mislaid?

THE design by Mr. Hendrickson, winner of the second prize in the City House Competition, will be published in the September number, and that of Mr. Wight, which took the third prize, in the October number.

ON Plate 51 (this number) may be found the measured drawing by Mr. C. H. Alden, Jr., of the arcade on north and south sides of cloister, San Zenone, Verona. A description with illustrations of the cloister of San Zenone is given with Street's "Brick and Marble in the Middle Ages" in THE BRICKBUILDER for September, 1894.

REPORT OF THE JURY ON THE BRICKBUILDER COMPETITION FOR A CITY HOUSE.

TO THE PROPRIETORS OF THE BRICKBUILDER:

Gentlemen, — The high average of excellence among the designs submitted to us made the task of your jury an interesting and not altogether an easy one. Comparatively few of the designs were really poor. After a careful study of all, two were found to stand easily first — not only in design, but in draftsmanship — viz., those marked with a "Door-knocker" and "Wren." These two were better planned, simpler, and more refined in design, better proportioned, and better rendered than any others. It was a less easy matter to determine between them. To "Door-knocker," however, clearly belongs the first place. The superiority over "Wren's" design is most apparent in the plan. The latter's entrance and entrance-hall are unpleasantly narrow. "Door-knocker," by a judicious disposition of his hall and staircase, and by placing his parlor in the upper floor, gains with an actually smaller ground plan a sense of amplitude and livable comfort that is lacking somewhat in the more symmetrical plan of his competitor. The width of entrance is a great advantage also to "Door-knocker's" elevation. The one fault of "Wren's" otherwise unusually graceful and well-proportioned design is the narrowness, the somewhat pinched look of the porch; and it may be added that the Doric order is the one of all others least adapted to treatment in terra-cotta, the triglyphs flatly contradicting the necessarily arched construction of architrave and frieze. "Wren's" elevation rather suggests that the principal rooms are in the second story, which the plans show not to be the case. "Door-knocker's" interior arrangement is well expressed in the façade; but both designs deserve high commendation, and are very much superior to the average house that gets built.

The jury found somewhat more difficulty in selecting the third prize, but the charming quaintness and piquancy of the design of "Bluenose," obtained by the simplest means, seemed, after careful consideration, to place it above the remaining competitors. Its simplicity and its carefully studied fenestration are especially to be commended. But the two bull's-eye openings just below the cornice are unfortunate and seriously mar the design. They might have been omitted entirely. The plan is good, but the shape of the window alcoves in the reception hall is objectionable.

In addition, the jury specially commends the designs of "Red Maltese Cross," "Greek Cross," "Bee," and "F. G. in circle."

"Red Cross'" plan is too much cut up; the bath-room is placed on an interior wall instead of on an outside wall, a fault that occurs also in other designs. The shape of the gable window and its treatment is ugly, and there is a want of complete harmony between the entrance arch and the adjoining window, giving an unpleasant restlessness to this portion of the front; but the design is picturesque and interesting.

"Greek Cross" wastes a great deal of room in halls and passageways. In spite of its undue enlargement, the hall is too small to make a two-story treatment pleasant, and its irregular shape is ugly. The façade is a straightforward and pleasantly proportioned treatment of the motive of a pilaster order, enclosing two stories with basement below and attic above.

"Bee" and "F. G." present designs of similar motive, the former somewhat better carried out and with a better plan. The Bramantesque windows of the second story in "Bee's" design are too wide to be pleasant in proportion and are somewhat out of scale, as is also the hood over the entrance. The cornice projection is much too great, especially for terra-cotta.

Greater care in the study of proportion is needed in both these designs; but the motive is good and is fairly well carried out.

Respectfully submitted,

H. LANGFORD WARREN.
C. HOWARD WALKER.
C. H. BLACKALL.

OUR ILLUSTRATED ADVERTISEMENTS.

ON page xix The Hydraulic-Press Brick Company illustrate in their advertisement the Eglise des Jacobins, Toulouse, which is a good type of brick architecture of the Middle Ages existing in the south of France. It was built towards the end of the thirteenth century, and the photograph shows how well it has withstood the test of the intervening six hundred years.

On the opposite advertising page of The New York Architectural Terra-Cotta Company will be found another fine Gothic church of brick and terra-cotta, but built in the waning years of the nineteenth century, in New York City, and of which Messrs. Barney & Chapman are the architects. It fronts on 14th Street and extends through the block to 13th Street, and comprises lecture, reading, and meeting rooms, necessary for effective parochial work in a thickly populated, working-class neighborhood.

The angel figure which we give here was modeled by Mr. H. Piccerilli, and is one of the finials placed on the shaft to each side of the four dormers on the tower.

The fine figure of St. Paul leaning on the sword of the Spirit fitly represents the church militant. It is the work of Mr. S. Stern, and will be placed in the niche prepared for it between the two richly molded and crocketed archways on 14th Street. Both of these artists are employed on the staff of the above company.

COMPETITION.

WE are authorized by the New York Architectural Terra-Cotta Company to announce a competition for the best design for a full-page advertisement to be used in THE BRICKBUILDER. The drawings must be made in line with black ink on sheets cut to the uniform size of 14 by 18 inches. For the best designs there is offered a first prize of $50, a second prize of $25, a third prize of $15, and a fourth prize of $10. The prizes will be awarded by a jury of three architects of acknowledged reputation. Each drawing must be marked with a motto or cipher, and a sealed envelope similarly marked containing the full name and address of the designer must accompany the drawing. These envelopes will not be opened until after the award is made. The designs for which prizes are awarded will become the property of the New York Architectural Terra-Cotta Company. THE BRICKBUILDER reserves the right to publish the successful designs. Other drawings, at the conclusion of the competition, will be returned to the competitors. Drawings must be delivered flat, express or postage prepaid, at the office of THE BRICKBUILDER not later than October 1.

TO DRAFTSMEN.

ANY draftsman out of employment, who will send us his full address and answer the following questions: —

By whom were you last employed?
Can you furnish good recommendations from your last employer?
On what particular line of work have you been engaged?
What salary do you expect to receive?
Are you willing to go to another city?

may have his name placed in our Exchange Bureau, and will be notified of any parties desiring his services as a draftsman.

All such communications will be regarded as confidential, and no charge will be made.

Address, EXCHANGE BUREAU,
THE BRICKBUILDER PUBLISHING CO.

TO ARCHITECTS.

WE call your attention to the foregoing announcement, and upon your application would be pleased to put you in communication with any draftsman whom we think would meet your requirements. All communications will be regarded as confidential, and no charge will be made.

Address, EXCHANGE BUREAU,
THE BRICKBUILDER PUBLISHING CO.

COMPETITION.

MR. WM. CONNORS, Troy, N. Y., the well-known manufacturer of "American Seal" Mortar, Stains, and Roofing Cement, authorizes us to announce a competition for the best design for an advertisement to be used in THE BRICKBUILDER. The wording which is to be incorporated in the design may be found in Mr. Connor's advertisement for this month on page xxiv.

The drawings must be made in line with black ink on sheets cut to the uniform size of 4 by 11 ins. Each drawing must be marked with a motto or cipher, and a sealed envelope similarly marked, containing the full name and address of the designer, must accompany the drawings. These envelopes will not be opened until after the award is made. The designs for which prizes are awarded will become the property of Mr. Connors.

For the best design, there is offered a first prize of $25, a second prize of $15, and a third prize of $10.

The prizes will be awarded by a jury of three gentlemen competent to judge of this class of work.

Drawings must be delivered flat, express or postage prepaid, at the office of THE BRICKBUILDER, not later than October 1.

THERE is a little paper published in Chicago called the *Clay Record*, the editor of which dropped his scissors long enough to pen an editorial in a recent issue, the purpose of which, we presume, was to annihilate THE BRICKBUILDER. We are not counted on earth by the writer of the article, because we are printing a translation of Choisy's "The Art of Building among the Romans" and reprinting Street's "Brick and Marble in the Middle Ages." We would inform the gentleman who wears "a 15½ E. & W. collar," and probably a 5½ hat, that Choisy's "The Art of Building among the Romans" is the subject of a special course at the Massachusetts Institute of Technology, and we think that a translation of this standard work, with the reproduction of Street's "Brick and Marble in the Middle Ages," which is now out of print, is of as much value to the readers of a technical journal as funny advertising poetry and a lot of cheap trade "taffy."

We are inclined to think that the real cause of this terrible heat "under the collar" is that some time ago we took this editor to task for "cribbing" from our columns without giving credit: also, that we asked him at the time if an editorial which appeared in his columns, claiming the leadership among the trade journals devoted to the interests of manufactured clay, had not been "cribbed" from one of the other papers.

If the editor in question has any more scathing (?) editorials for us which he would have widely read by the clay workers of the country, we would suggest that he hire space in Brother Randall's paper.

BRICK AND MARBLE IN THE MIDDLE AGES.

G. Edmund Street.

CHAPTER VIII. — *Continued.*

THE assumption that the Piazzetta-front has been copied from the sea-front involves a belief in a veneration for an exact imitation of older work which is (to say the least) extraordinarily rare, if not unique, in mediæval works. It involves a belief also in the possibility of a spirited and successful copy being made of an old capital by a mediæval sculptor without fresh thought or any fresh invention of any kind. This will be seen if we examine the capitals of the lower stage of the palace. Here, at first sight, one is struck by what appears to be the astonishing variety of the capitals. They are nearly all adorned with figures or subjects, as well as with foliage, and are certainly in both fronts of various degrees of merit; but on closer acquaintance it is perceived that the variety of capitals is not so great as it seems, for that several of those in each front are merely replicas of those in the other. If any portion of the two lower stages had been built before the rest, it would have been the whole of the sea-front and six arches of the Piazzetta-front, for at the end of these there is a column equal in size to those at the angles, and which might therefore by possibility itself have been an angle column for a time. But its larger size may also fairly be accounted for by the fact that it comes under the side wall of the large building above, and was in any case, therefore, a convenient arrangement, if not quite a necessity; but the real difficulty seems to me to be that if there were any considerable difference in the date of these works all experience would lead one to expect that the earlier works would be the most uniform and the best, whereas in point of fact this is far from being the case. For instance, in the sea-front there are various capitals which are of poor execution. These are, counting from the southeast angle, the third (large and coarse heads), the eighth (also coarse heads), the thirteenth (lions' heads), the fourteenth (beasts), and the fifteenth, which is certainly not so fine as the replica in the Piazzetta-front (the twenty-sixth capital, counting as before). [1]

The case for the contemporaneous erection of these two fronts becomes even stronger if we ascend to the open gallery on the first floor and examine the capitals there. They are all similar in general character; and, though they become gradually better as one goes from the southeast to the northwest, they give the impression of all being of nearly one date, and moreover they all appear to be later in date than the whole of those in the lower stage.

On the other hand, there seem to be at least two points which make strongly in favor of the later date which has been given to the twelve northern arches of the Piazzetta-front. These are, first, that all the eight capitals which are replicas are in this northern part of the front, and none of them in the first six arches from the southwest angle; and, secondly, that the plate armor in the sculpture above the capital of the northeast angle (Judgment of Solomon) is later in date than the period which I assume for this work, and later than the chain mail shown in the third and eighth capitals of the sea-front. To the first objection a sufficient answer is that some of the best of the capitals to these twelve arches are of original design, not replicas; and in reply to the last objection (which is of much force) the only but at the same time obvious reply is that the Trajan capital, just under this late armor, is one of the most beautiful of the entire series, and that, on the whole, it is much more likely that some of the sculpture was left in block and finished later; than that no difference should be made in any of the moldings or details of the work of two periods. There is, indeed, some, though not very strong, evidence that the sculpture of this capital is not earlier than about 1423. There is, according to Zanotto, an inscription on it, "+ *Duo Soci Florentini incise*," and he argues from the use of this last word that the two men were the same who made the monument to the Doge Tommaso Mocenigo in 1423, in which, according to Sansovino, they used the same unusual term "*inciserunt*"; this interpretation of the inscription is the more allowable in that, as I have said, the details of armor in themselves suggest a date not much earlier than this for the sculpture connected with it on the angle just above the cap. This date, of course, brings this work to very nearly the same period as that of the execution of the Porta della Carta, and it has been assumed by some that these capitals were the work of the Bons who built it. Such an assertion is as wild as that of M. Didron, who says something as to their belonging to the thirteenth century, for the very shortest inspection of the Porta della Carta would convince the most skeptical that no part of the capitals could have been executed by any of the men who wrought at it. In comparing the merits of the carvers of the earliest and the latest capitals, it is due to the latter to say that one of the finest of the whole series is this Trajan capital at the northwest angle, and there is no internal evidence in it which could lead one to suppose it to be the work of a man who would ever condescend to copy another's work.

No one can examine the building without seeing that there is, not only in the detail, but equally in the general design, a marked difference between the two lower stages and the upper stage. In place of the extreme boldness which marks every part of the former, we see moldings reduced in the latter to the smallest and meanest section possible; the windows of the upper stage are badly designed, whilst the traceries of the second stage are as fine as they can possibly be; the angle-shafts of the upper stage are of the latest type, elaborately twisted and violently defined, instead of being merely delicate roundings off of the hard line of wall, as all the early Venetian angle-shafts are; the parapet, too, is not equal in its design to any of the lower work, and crowns with an insignificant grotesqueness the noble symmetry of the two lower arcades; and finally, the chequer-work of marble which forms the whole of the upper wall is a mode of construction which I have not seen in any early work, though it is seen in the Porta della Carta (A. D. 1429), and in one other late work, the Palazzo in the Campo Sta. Maria Mater Domini. [1]

Looking at all the circumstances of the case, I think the fairest explanation of them is that the whole sea-front and the six arches of the Piazzetta (columns 1 to 24 on the plan) were first built, that the extension to the north (columns 25 to 36 on plan) was then immediately undertaken by the same artists, and finally that the whole upper story was built and the sculpture of its capitals completed before 1423. The capitals of the lower arcade were probably sculptured by degrees, and certainly not by one hand, between the years 1310 and 1361.

There is a confirmation to some extent of this view in a MS. in the Bodleian Library of the fourteenth century (the Romance of Alexander), which contains a curious contemporary view of Venice. This drawing has been engraved at page 26 of the second volume of the "Domestic Architecture of the Middle Ages." [2] Here, it will be seen, with the usual amount of license which characterizes most mediæval representations of places or towns, that it has nevertheless been intended as an absolute representation of what its draughtsmen had seen. The columns with St. Theodore and the lion of St. Mark on their capitals, the bronze horses and the domes of St. Mark's, the position by the waterside, and the representation of the Ponte di Paglia are all proofs of this; but the important point for my present purpose is that he drew the Ducal Palace as *a building*

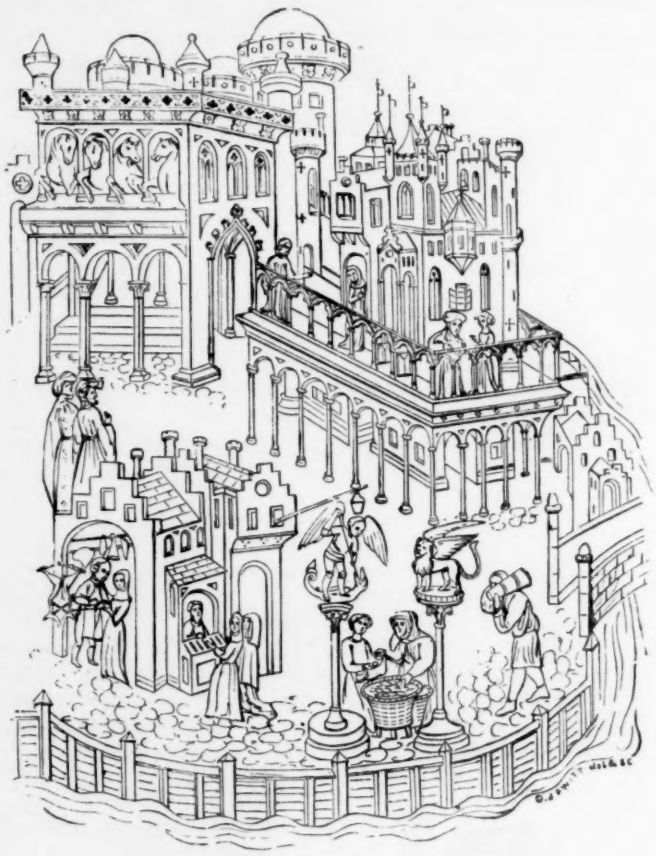
[1] The capitals which are replicas of each other are the 4th and 35th, the 7th and 28th, the 8th and 31st, the 9th and 29th, the 10th and 30th, the 11th and 34th, the 12th and 33d, the 15th and 26th. The 25th, 27th, 32d, and 36th (northeast angle) are original, though they are in the northern portion of the Piazzetta-front. See Appendix, with key-plan.

[1] The similar marble facing at Vicenza was executed between 1400 and 1444.

[2] Published by Mr. Parker, of Oxford, to whose courtesy I owe the use of this illustration.

of two stories in height — the first a simple arcade, the second an arcade with tracery. In the distance behind this his drawing shows a picturesque assemblage of buildings, whilst figures are represented behind the upper arcade, as though it were only a kind of immense balcony. There can be no doubt whatever that this old drawing tells in favor of the view that the upper stage was not built until after a considerable interval; for it is almost impossible — looking at the way in which the rest of the drawing is made — to believe that all reference to it would have been omitted, had it been in existence at the time the artist saw it.

It will be seen that my supposition that the original design of the Ducal Palace was of considerably less elevation than the present building would tend to make it very much more like the Byzantine type than it is; but even now no one can dispute the family likeness. The amount of constructive art is as nearly as possible the same. The weight is supported by a succession of shafts placed at very short intervals from each other, and in neither is there any approach to the system of pier, arch, and buttress so distinctive of Gothic art in the North of Europe. The pointed arch is used, it is true, in the palace; but, after all, the mere use of the pointed arch does not make thorough pointed architecture, and, therefore, interesting as it is as a variety of the style, the Ducal Palace is, I think, not properly to be placed in the first class of Gothic buildings. Indeed, the second stage, whose exquisite beauty is the charm of the whole building, does not exhibit the pointed arch at all in a properly developed form, and is strong enough to support the great weight of wall above only by reason of the massy character of its tracery, and not by the proper application of constructional arches. I have already said that there is no approach to buttressing; but the angles require some help, and this is given partly by increasing considerably the size of the shafts and partly by iron ties at the springing of the arches running for some distance in each direction from the angles.



VENICE IN THE FOURTEENTH CENTURY.
From the Romance of Alexander.

All the moldings are very simple; they are generally composed of three-quarter beads, small fillets, and large flat hollows, constantly arranged in the same order. The label of the main arcade is a plain bead. In the string-courses boldly carved flowers are repeated with a slight interval between each, and the upper string-course has a row of nail-heads in one of its members. The cusping of the tracery is quite square in its section, and the cusps finish with a square end, to which is attached — and with good effect — a small circular ball of red marble. The parapet is of the somewhat peculiar kind I have already mentioned, and I confess I have never been long enough in Venice to accustom myself to or to admire its extreme peculiarity of both outline and design.

And now, before we leave this subject, let me offer a remark, as every one who writes on it must, on the admirable story of these sculptures. I have never sat in front of one of them for any space of time without seeing some wayfarer stop to study the story of some one of the capitals. They are a book at which more thousands have looked with pleasure for some five hundred years than at any other single book in the world, with the one exception of the Bible. And the lesson to architects is obvious. Concentrate your labor and your story on some one part of your building where all men may read it; tell some simple story, and you will interest your readers, if you will but tell it so simply that by good chance they may be able to read it. Lay out a scheme so well that if you die your successor may carry it on. Here, as I believe, the architect completed his two stages of arcades, whilst the sculptor was changed, but kept generally to the scheme of subjects first of all laid down. At the three exposed angles are the three archangels; below them the moral lesson — as much wanted now as then — of the Drunkenness of Noah, and the Story of Tobit (with St. Raphael); at another angle, The Fall (under St. Michael); and at the last the Judgment of Solomon (under St. Gabriel). In the lower range of capitals the stories and catalogues of virtues and vices; the illustrations of fruits, animals, every-day life; the labors of the months, trades, sciences, and arts are all illustrated, and complete a cycle of subjects which, ill treated, would always have a certain value, and which, well treated, as most of them are here, have the very highest charm.

(*To be continued.*)

FACING BRICKS.

BUILDING in brick has been resorted to in this country for a long time, says a writer in an English journal. Not so on the Continent, where brick has come into more extended use only in recent years. The taste for brickwork is spreading everywhere, not only in districts poor in quarry stone, but all over France, Germany, and Switzerland, where, even for buildings of some architectural importance, rough masonry work was the prevailing mode. In Switzerland, especially, where the workmen have had little experience, building with brick is looked upon as expensive and luxurious. In consequence of the prevailing tendency of combining the beautiful with the useful, facing bricks of various sizes are now manufactured in Germany and Switzerland, by the employment of which builders are enabled to erect walls for nearly their whole thickness of bricks or cement slabs, even partially of quarry stones, which may be obtained everywhere at very low rates, especially now, and to face them afterward with a finer description of bricks. Bonding is preserved in the usual manner by joining the inner bricks in such a manner as to use for facing alternately quarter, half, or three quarter bricks. This way has the advantage, besides cheapness, of permitting the facing bricks to be put in afterward, so that they cannot be soiled or damaged.

The bricks are made hollow, by which means a considerable saving is made in the cost of carriage, and, in order to secure a better hold for the mortar, provided at the sides with ribs and grooves.

THE ART OF BUILDING AMONG THE ROMANS.

Translated from the French of AUGUSTE CHOISY by Arthur J. Dillon.

PART II.

CUT STONE MASONRY AND ROMAN FRAMING.

FIRST CHAPTER.

GENERAL METHODS OF CUT STONE CONSTRUCTION.

(*Continued.*)

ONE thus perceives the influence exercised on ancient art by this method of preparing the materials, whose most remarkable examples date from the sixth and fifth centuries before our era. The aspect of edifices whose construction was often interrupted, accustomed the eye to the roughed-out forms of the preliminary cutting. Later, their age itself consecrated them, and, introduced into the architecture to satisfy practical exigencies, they were kept there by the strength of tradition, and persisted long after the abandonment of the methods from which they arose. Certain combinations passed, little by little, from the domain of the art of building to that of decoration; and the spirit of the architecture was insensibly modified, although the outward form remained almost invariable.

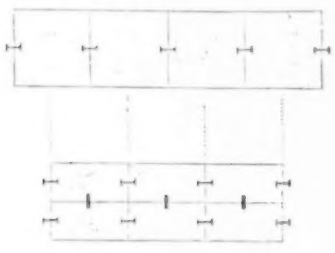


FIG. 64.

These changes, however, had but a mediocre influence on the general character of cut stone masonry, and the arrangement of the stones continued to be, in the last days of Grecian art, that which it had been in the sixth and fifth centuries. This (Fig. 64) is what it usually was in the primitive architecture of the Greeks; and such it was in Rome during the entire period of the Empire. There is never to be seen some stones in a course traversing the wall, while others extend but partially through it; either all the stones of a course extend through or else none of them do so; a course of bond stones or headers (Fig. 64, first sketch) alternates regularly with two courses of stretchers (Fig. 64, second sketch).

This type is the conventional one for all walls built entirely of cut stone; and, under this head, it applies to all cases of Grecian construction. But when it was necessary to combine revetments of cut stone with backings of rubble the consecrated forms had to be modified, and then the builders invariably used one or the other of the two forms shown in Figs. 65 and 66. Either they alternated courses of headers with courses of stretchers, as in Fig. 65, or else (and this was the most frequent solution) they alternated courses of stretchers with courses composed of both headers and stretchers (Fig. 66). In a word, it was either the alternation of courses of headers and courses of stretchers, or it was the alternation of courses of stretchers and courses of both headers and stretchers. These were the two ways; and in no Roman edifice have I found two mixed courses directly superposed; everywhere a course of stretchers is placed between the bond courses, so that the stones that project into the rubble reoccur only in every second course, a combination which, essentially economical, has, moreover, such advantages of solidity that its use can be recommended at the present time.

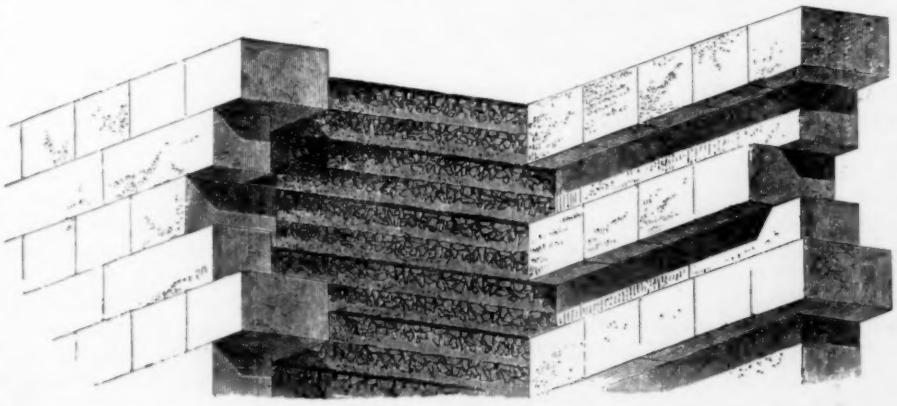


FIG. 65.

It is not, in fact, the question in obtaining a good bond of simply multiplying the stones that penetrate into the backing; these headers, if too near together, cut up and divide the rubble which they penetrate, so that it tends to give way at the first effort to pull them out. The arrangement shown in the last figure would seem to diminish this danger to such a point as to render it fictitious. In this combination, the headers are so many strong, isolated ties which pierce the rubble from point to point, near enough together to bind the revetment firmly to the backing, but far enough apart, in every direction, to assure the strength of the rubble which separates them.

The applications of this system are unending. It is the arrangement of the sub-basement that carried the tomb of Cecilia Metella; it is that of the other circular mausoleum, between Rome and Albano, which is known as the Casale Rotondo. In these monuments the stretchers of the revetment have almost all been torn off by main strength, and the headers, broken off flush with the rubble, appear as isolated white rectangles on the gray background of the walls. Lastly I will cite the buttressed wall of Roman construction which upholds the platform of the temple of Jupiter Olympus in Athens (Fig. 67). Here, again, the headers occur only in every second course; and this is the characteristic of the revetments of the ancient rubble masonry.

A well-known and characteristic detail of ancient masonry of cut stone is the absence of mortar in the joints. Even when the stones were built in connection with rubble concrete they were laid dry; and this practise, far from being limited to works whose object was decoration, was extended to those where the thinness of the joints would seem a matter of indifference, as, for instance, to partition walls that were to be plastered, and even to walls used as foundations.

In order to comprehend this exclusion of mortar, we must go back to the theory that the Romans had of its rôle; with them it was a binding material, nothing more, and they never thought of using it to transmit pressure or to level up the beds. In using it in their concrete construction, they gave it a single function, which was to bind the small stones together, as a sort of plastic matrix. In a construction of large, regularly shaped material the mortar was not strong enough to produce a similar effect, so they then looked on it as useless, and employed, to bind the blocks together, pieces of iron leaded in.

I will not stop to describe the different kinds of ties they used to clamp the stones together; here, again, they found in the Grecian edifices models that they were content to follow. The Greeks always made the ties of iron, never of bronze, and the only material used to solder them in was lead. The Romans imitated

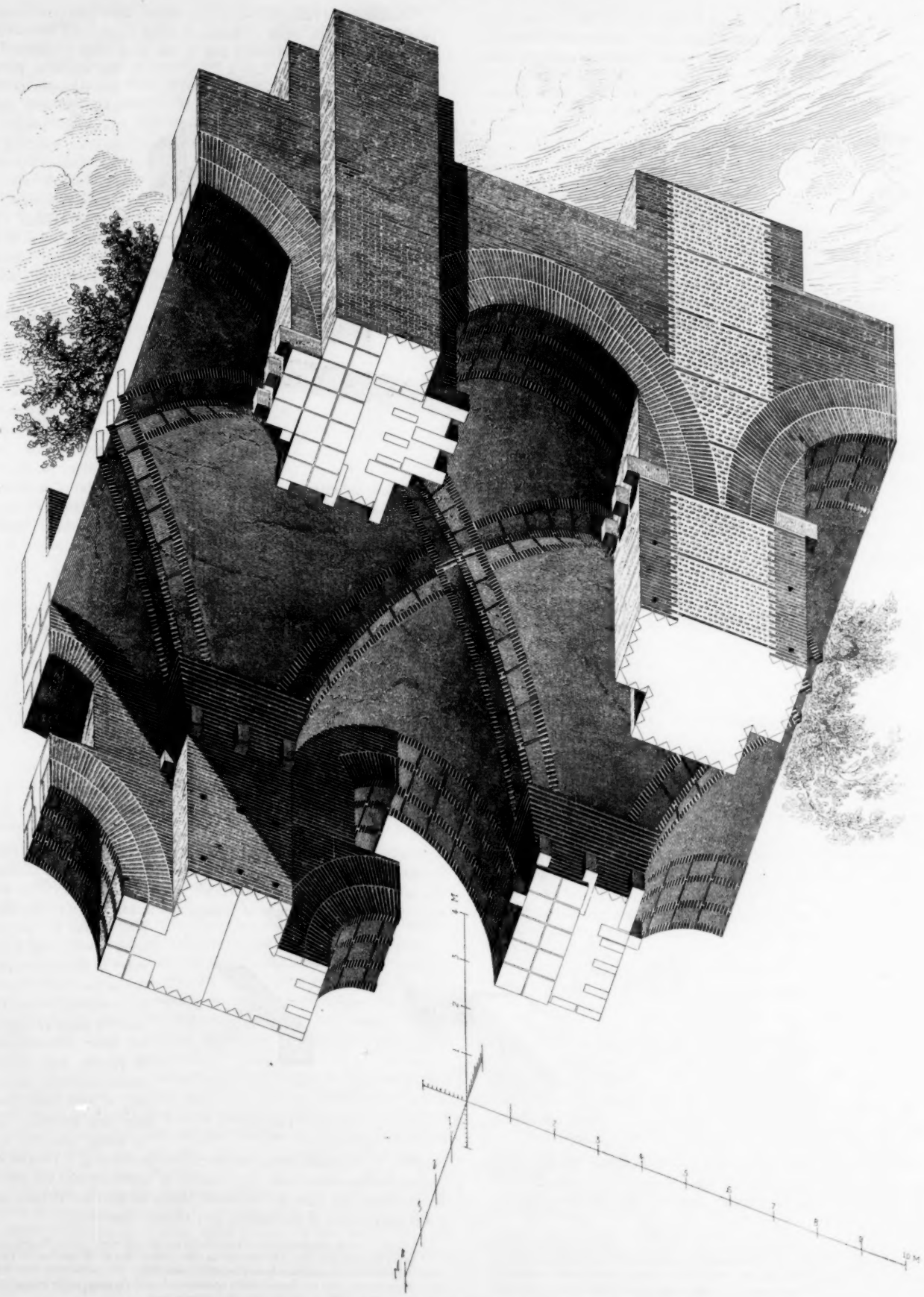


PLATE VIII. THE ART OF BUILDING AMONG THE ROMANS.

them, and the three types given in Figs. 68, 69, and 70 are found again in their buildings. Sometimes they substituted dowels of metal, of wood, or even of marble, whose shape and use are shown in Fig. 71, taken from a bridge in the south of Gaules, the bridge of Gallargues. But more often the Romans used a dowel (Fig. 72) thicker at the ends than at the middle, which was leaded into the upper stone. When this was set the dowel was engaged in a mortise in the lower stone, in which it was fixed by running lead into the mortise through a suitable channel, previously cut. This system, which seems the most recent, was the most general; but its use, far from assuring the security of the buildings where it was employed, was indirectly a cause of their destruction. The metal buried in the walls excited the cupidity of the barbarians who succeeded the Romans in Italy, and the channels filled with lead were so many clews to its hiding-places; so that the greater part of the ancient monuments show in the places formerly occupied by the metal clamps roughly drilled holes, made in extracting the iron and lead.

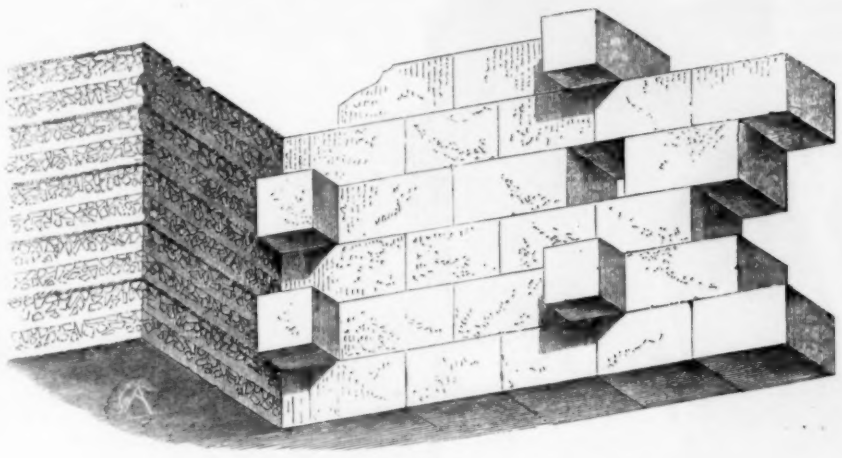


FIG. 66.

FIG. 67.

We now come to the question of handling the stones and of the means the ancients had at their disposal. A well-supported opinion has it that they were content with incline planes over which to drag their material to its final position. I do not know what basis there is for this view; it is perhaps the true one when limited to the edifices of gigantic stones which mark the infancy of civilization; but to extend to the Greeks, and particularly to the Romans, the idea of constructing temporary roadways for the sole purpose of carrying their materials to the top of their edifices is, I believe, to credit them gratuitously with a method whose costly simplicity is not in harmony with what we know of their tendency to free themselves from auxiliary works. Only a few vague texts can be brought to support this view,[1] while, on the contrary, the direct testimony of the ruins, agreeing with what seems to be the truth, is evidence of methods that are at the same time less primitive and less costly.

FIG. 68.

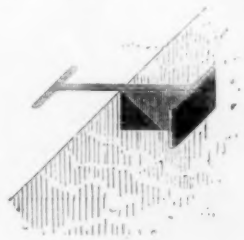


FIG. 69.

FIG. 70.

[1] For example, a passage of Pliny, relating to the lintels and architraves of the temple of Ephesus (Hist. Nat. XXXVI. 21). The passage is very obscure; but one can at least distinguish in it a reference to an inclined plane (*mollis clivus*) made of sacks of sand; the stones of the architrave were dragged up this slope, and, after being raised a little above their supports, were lowered on them by letting the sand run slowly from the sacks.

Sometimes (Plate XXIV. 5) the stones show horseshoe-shaped grooves on opposite faces, by means of which ropes could be attached for raising them; sometimes a hole of the same form is hollowed in the stone to permit the insertion of the rope for the same purpose. Again, a mortise, widening at the bottom, reveals the use of the ingenious system of wedges which the moderns use under the name of "lewis" to fasten the ropes to the stones; or else two holes drilled near together seemed placed to give a hold for a sort of tongs or chain lewis mentioned by Vitruvius as among the implements used for handling stones.[1]

These indications alone reveal to us a whole series of machines, more or less well made, but which may have differed essentially from those which we use at present. Thus the use of the lewis implies the use of ropes and of pulleys, fixed either to special masts or to scaffolding; and the size of the masses moved by the ancients gives us reason to believe that the pulleys were arranged so as to increase the power by lessening the movement. Moreover, the texts are precise; we find the principle of pulleys and tackle shown in the theoretic works of the ancient Greeks; and Vitruvius[2] in the first century before our era indicated in his treatise cranes, the different kinds of rigging for them, combinations of cranes, and windlasses, capstans, sheers, etc., all with such clearness and precision that in going over the first chapters of his tenth book one seems to be reading a treatise on modern hoisting machines. It is useless to describe under the names the Romans gave them the apparatus which we daily see in use; and I will limit myself, in concluding, to a general observation.

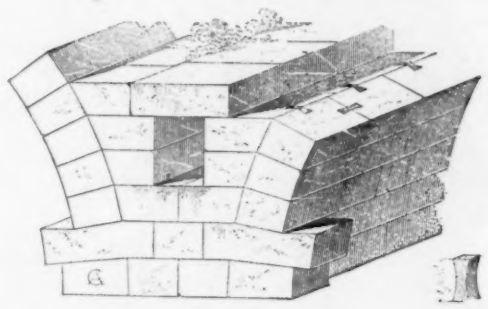


FIG. 71.

[1] "*Ferrei forfices quorum dentes in saxa forata accommodantur.*" (Lib. X. cap. 2.)

[2] Arist., Mechan. cap. xix. One can get an exact enough idea of the chapters of Vitruvius relative to hoisting machines from Perrault's translation. The commentary is far from being irreproachable, but the figures which accompany it give the sense of the text so faithfully that it seems useless to give here a new interpretation.

When the edifice being built reached such a height that a derrick resting on the ground was not high enough to raise the stones the Romans avoided as far as possible the erection of those great scaffoldings that gives one the idea of one building enveloped in another. True to their principle of reducing the auxiliary work, they built stagings carried on corbels, which were moved as the building rose. This was the case at the bridge of Narni, the aqueduct of Gard. . . . The isolated corbels, projecting from the faces of the piers and tympanums, show plainly the conception of these movable stagings. Nothing is more simple to imagine than a sort of crane that rested on the projections; once the inner end of the corbels were built in, they would be quite stable enough to carry it, and it would be in no way cumbersome, and could easily be moved. It is sufficient to get an idea of the principle and its advantages; in studying the arrangement of the corbels, the details

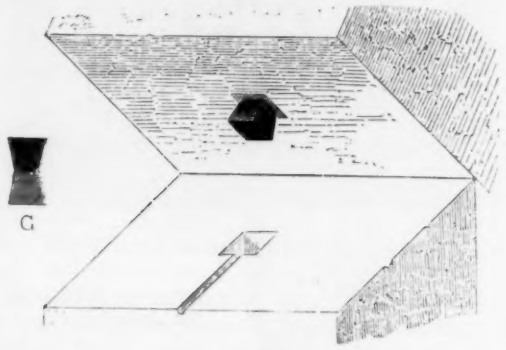


FIG. 72.

and essential characteristics of its applications could be discovered; but I wish to abstain from advancing a hypothesis where theory would perhaps have too large a place. I will keep to generalities on the practical methods of cut stone construction in ancient times, so there remains to be studied but the two principal subjects, monolithic lintels and keyed arches.

(*To be continued.*)

COLORING ARCHITECTURAL TERRA-COTTA.

THERE is no device resorted to by the clay-worker that is alike so inartistic and so ineffectual as attempting to give to architectural terra-cotta blocks a finer color than they naturally possess. The coating of such blocks with pigments or washes or the staining of their surfaces is never of a lasting nature; it soon wears off under the combined action of rain, smoke, frost, and other influences of an atmospheric nature.

"Then what are we to do if our clay will not yield a good color?" some may say. Well, the only course open is to determine whether it is admissible to use chemicals in the composition of the blocks, so that increased tone of color shall be due, not to a superficial film, but to the mass itself. Obviously, this will be governed entirely by (1) the cost of the chemicals, (2) the facility with which they can be applied; and these conditions, again, will be governed by the price which can be got for the goods.

If the selling price warrants the expenditure of labor and chemicals, by all means color the mass throughout; but if, on the other hand, the extra labor and expense would not be recouped, it is clear that the best course to adopt is to abandon the manufacture of the blocks, for which the particular clay is obviously unsuited, and exploit the clay for other purposes.

Washes and stains, however, are never permanent, and permanence is the first quality that is demanded in architectural facings. If these principles were more often present in the minds of clay-workers, we should not see so many ghastly failures in our streets, failures which only tend to bring our industry into disrepute. — *British Clay-worker.*

EARLY GERMAN BRICKWORK.

IN the early examples of the brick style the more elaborate parts, including the tracery of the windows and other molded work, were executed in stone. Horizontal bands of stone were also occasionally introduced, and they have a good effect in tying together the different part of the composition, besides their value in a constructive point of view. But in the later examples, from the end of the fourteenth century, stone is entirely dispensed with, and we find even such parts as crockets and finials executed in brick. The use of dark brown or black glazed bricks was also common during the later period. The character of the moldings varies, of course, somewhat in the different periods, being simpler in the earlier and more elaborately subdivided in the later. Delicacy of profile can hardly be expected from the nature of the material. Molded bricks were also used to make up general forms, such as circular piers, the inner side of circular turrets, etc. There are a few points in the construction of the buildings which ought not to be passed over. There is usually a granite plinth carried all round the churches, and the towers are faced with the same several feet up. The absence of buttresses to the towers rendered it necessary to increase the thickness of the walls, which we find is very considerable, notwithstanding which they mostly incline from the upright, and it is remarkable that this occurs most frequently towards the southwest. The mortar joints are invariably very wide (from ½ in. to ¾ in., or even more); the mortar itself is extremely hard. The construction of vaulting claims particular attention. In the first place, a light material was prepared in bricks, molded of a wedge form. The ribs seem to have been first constructed independently as a skeleton, and between them the spandrels were filled in with the light bricks, apparently without the use of centering, as each spandrel is considerably arched up to enable it to support its own or any superincumbent weight. Thus the vaulting rests entirely on the ribs, which are not tailed into it. It is a single brick in thickness, about 6 ins., and is backed up only a very short distance above the springing, so that the form is very distinctly seen on the upper surface, where it presents a very remarkable appearance. The bond used throughout is the Flemish, or, as it is now called, the crossbond. The arches are always built in half-brick rings. The bricks used in the buildings are of a larger size than those now commonly used in Germany. They are remarkably hard and sound, and are rather heavy; though externally of a brown-red color, the inside is gray, like our stocks. This is not the case with those now made. The light vaulting bricks were made with a mixture of chopped straw, so that when burnt they were porous, but of sufficient strength for their purpose. The first-class bricks, as a material, are superior to those used in this country; the color uniformly red, except where a vitreous action had been produced in the burning. There did not appear to have been a rubbing down of the face of the material when used for mullions or tracery; the ordinary examples presented too rude a surface to suppose such an operation.

EXHIBITION OF THE CITY HOUSE COMPETITION DRAWINGS.

WE have selected twenty-five sets of the drawings submitted in the City House Competition for exhibition in the larger cities of the country.

These drawings have been very neatly mounted on binder's board, size, 20 by 30 ins., and all prepared for hanging.

The drawings selected are pronounced by the judges as being of a high order and most interesting character, and well worth exhibiting.

Arrangements have already been completed to exhibit the drawings in Boston, New York, and Philadelphia. We should be glad to make similar arrangements with clubs in other cities. Dates for exhibiting will be made in the order in which the applications are received. The drawings will be sent in a case specially prepared for the purpose, and all transportation charges will be prepaid.

ARCHITECTURAL TERRA-COTTA.

BY THOMAS CUSACK.

(*Continued.*)

SANTA MARIA DEL CARMINE of Pavia, built in the fourteenth century, shows the influence of the Gothic, which in Northern and Western Europe had ere this reached its zenith. The windows are filled with tracery, and the great rose window is surrounded with a number of little faces and figures modeled in terra-cotta, and alternating with cabled and dentiled moldings, all relics of the earlier Romanesque. The interior columns and piers are constructed of terra-cotta bricks, and, "notwithstanding their thousands of component pieces," says the writer already quoted, "their shape appears faultlessly cylindrical, and so neatly are they fitted and jointed together, that it is only on very close inspection that the joints become distinguishable, and not even so much as a penknife can be inserted between brick and brick."

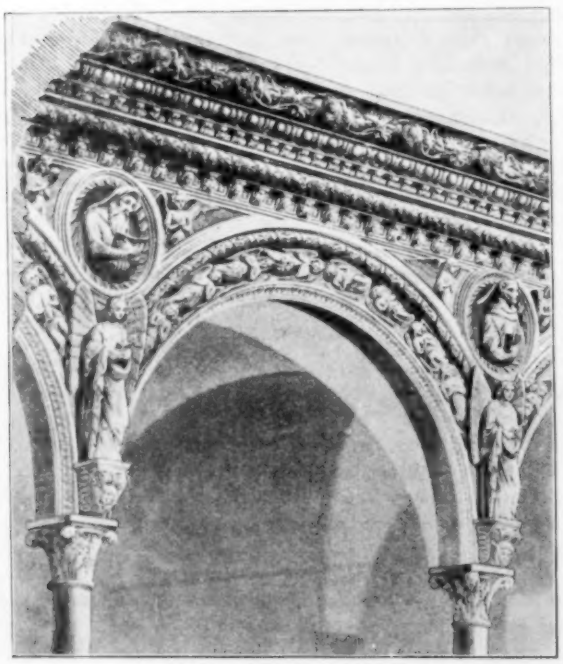
Good use was evidently made of the tax imposed upon widowers contracting a second marriage, from the proceeds of which it seems that the church was erected. Much better this, though doubtlessly less popular, than our plan "of setting 'em up for de boys."

The Cathedral of Crema, built early in the fourteenth century, has rounded as well as pointed arches, filled with delicate tracery, in the details of which no two windows are alike, yet with sufficient kinship to secure harmony, just as Pope has it: —

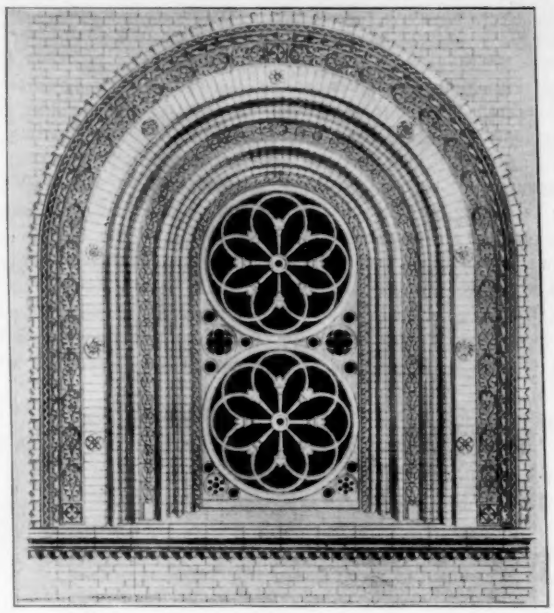
> "Where order in variety we see
> And where though all things differ all agree."

Space will permit of but one example, and the same reason may be given for restricting our reference to all save the most typical of the structures now under consideration, in this veritable home of what might be extended into a volume, entitled Brick and Terra-cotta in the Middle Ages.

The foliated ornament is also varied, in every window of Crema, showing that the artist was able to resist the temptation to make a commercial use of a set of molds, and that he abhorred a tiresome repetition of the same patterns, as much as nature does a vacuum. The same remark will apply to the capitals in the arcading of the



ARCADE FROM CLOISTERS, CERTOSA PAVIA.



WINDOW, CATHEDRAL OF CREMA.

pediment, which forms a characteristic feature in all Lombard work. The color in this case is a light orange, of which Mr. Lose says he has "as yet seen no second specimen," adding, "of all the edifices I know, this displays the best and most careful workmanship. Close inspection is necessary to discover how much precision, skill, and finish have been bestowed on those figures and that foliage, which to-day remains as if newly wrought."

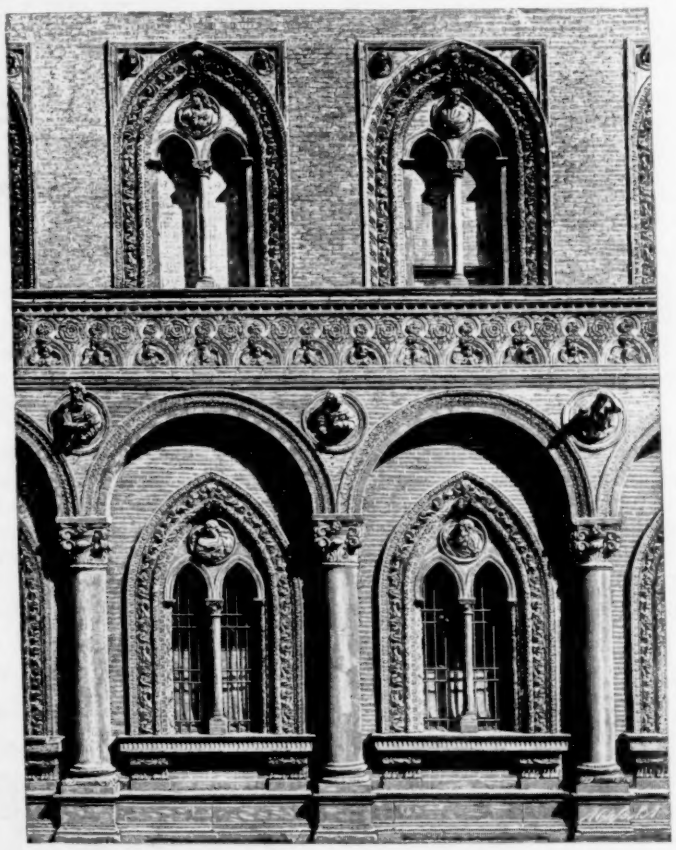
In the church of San Rustico at Caravaggio we have a good type of the Lombard, in which effect is obtained by strong architectural lines, and hooded niches for figure sculpture, without tracery or foliage. The adjoining campanile with panels, pilasters, string-courses, and cornices, all in brick, indicates a reversion to classical precedents.

The famous Certosa of Pavia which an ancient historian has described as "the finest beyond all others" covers a parallelogram of about 420 by 330 ft. It is surrounded on three sides by a cloister of 123 arches, of which we give a general perspective and illustrations of two arches. A full-size replica of one bay has been added to the casts of the Metropolitan Museum of Art, New York. It will be found suspended underneath "Diana's Hunting Party," where, fortunately, we were able to recognize it without the aid of a catalogue, the prolonged absence of which renders the Willard Collection of Architectural Casts less instructive, and, indeed, goes far to defeat the object of its donors. Each spandril medallion frames the bust of a saint or father of the church portrayed in some act of devotion. The allegorical figures have slightly varied poses and expressions, which Wordsworth might have described as a "similitude in dissimilitude." The grape-vines have not been unduly conventionalized, and the troops of little images around the arches look as if they all had been specially modeled, or, if not, they must each have received their individuality after leaving the mold. The prolific fancy of the artist must have been allowed free scope for tangible expression here, and, to his credit be it said, the ductility of the material in which he worked did not lead him into grotesqueries or unbecoming vagaries. The general view of this composite work of architecture, science, and art, shows that the massing of the whole group was in the hands of a master. We doubt whether a more striking example of scenic and picturesque effect can be instanced from among similar works of mediæval or modern architecture. This is subject to the exception of the western façade, which was added about a century later, and has been severely condemned by Street, and other far less exacting

critics. The original pile of glowing red brick and terra-cotta does not greatly suffer in this connection, however. The magnificent mongrel designed by painter Borgognone is in marble and precious stones, producing "a gorgeous richness," which Leader Scott thinks "better not to analyze too closely." This same art critic is, on the other hand, loud in his praise of "the exquisite terra-cotta decorations." But the application of architectural terra-cotta had here touched its high-water mark. The Cinquecento school led the way to lower stages of decline and degeneracy, culminating in bizarre and inartistic rococo, and with it terra-cotta disappeared in Italy until its revival in the present century.

The towers and campaniles built of brick and terra-cotta are a distinguishing feature of mediæval architecture in Italy. Viewed from a distance, they stand in the same relation to the skyline of an Italian city, as do the minarets to Stamboul or Constantinople. In time they came to be so plentiful, and remained so uniformly firm and erect, that certain architects exhibited a wild craving for something that would be novel, if not altogether original. Goethe tells us that "every man wished to make a show with a tower, and at last straight towers became so commonplace that leaning towers were erected" by way of contrast and distinction. Whether intentional or not we need not stop to inquire, but certain it is that Bologna is the proud possessor of two of these. Her architects, however, have done something to atone for these eccentricities, or faulty foundations, as the case may be, by giving us many good specimens of brick and terra-cotta, one of which is the Palace of Fibbia.

The Castle of Pavia was erected in the fourteenth century by the all powerful Duke of Milan. It inclosed an immense quadrangle, on three sides of which were Gothic arches on the first story, and a combination of Gothic and Romanesque arcading on the second, chiefly in brick and terra-cotta. Brentano informs us that "this range of buildings was of capacity sufficient to lodge the court of any king or emperor whatsoever." It has long been a ruin, however, and but little of it now remains to mark the place of the once magnificent edifice. This was not due to any deficiency on the part of the materials of which it was built; but thereon hangs a tale, and, briefly, it is as follows: In 1527 Italy had been turned into a sanguinary battlefield between Francis I., whose armies had crossed the Alps to meet those of Charles V., already in possession of the country. The conflict between these two monarchs seems to have been fomented by the intrigues of Wolsey, who was particularly anxious to obtain the popedom; and on its result depended another important question, viz.: whether his master, Henry VIII. of England, would obtain his divorce from the aunt of Charles, Catherine of Arragon. Needless to say that these issues were weighty and far reaching, but we are concerned here, only with the immediate consequence, which, though trivial by comparison, was very disastrous to the Castle of Pavia. According to the authority just quoted, "This palace had four great towers, but now there remain only two towards the city; the other two were broken down by the artillery of Gascon Lautrec."



PORTION OF THE FACADE OF THE OSPEDALE MAGGIORE, MILAN.

Among other secular buildings almost wholly of brick and terra-cotta, the great Ospedale Maggiore, Milan, heads the list of those in Italy. And with it we must hasten onward in our rapid summary to other lands where these materials have been, and are still used profitably and with good effect, owing in no small degree to Italian example and inspiration. Architecturally, it is one of the few instances where Gothic, Romanesque, and early Renaissance features have been successfully blended, without producing a hybrid such as the western façade of the Certosa of Pavia. Carl Von Lutzow, in his "Art Treasures of Italy," says that "brick architecture has scarcely produced another building of equal beauty; nor has anything more decorative been executed in terra-cotta than these two stories, with their pointed windows divided by columns, the rich plastic garlands which surround them, and the effective medallion heads which ornament the building." The oldest portion was built about the middle of the fifteenth century, and is credited to the Florentine architect, sculptor, and author, Filarete. He, like his more famous countrymen, Brunelleschi and Michael Angelo, was no mere picture-maker on paper, whose tools of trade are limited to a pencil, rule, and tee-square. He belonged to the famous school of mediæval "master masons," who, confined to no country, labored in Italy, Germany, France, and England, before Art — at the instance of "the profession" — was divorced from Industry, to the irreparable loss of both. In each of these countries their work remains in an enduring form, and the inscription in St. Paul's over the grave of Wren might with equal propriety, but in a still wider sense, be applied to them also. "*Si quæras monumentum circumspice.*" These four words — to transpose Walpole — would comprehend their merit and their fame.

The late Mr. Street was an artist beyond doubt, but he did not care to have his beloved thirteenth century Gothic mixed with anything. He preferred it straight and uncompromisingly pointed, as in the New Law Courts. Yet in a foot-note to the 1855 edition of his "Brick and Marble," etc., he makes graceful apology for not having seen the Ospedale Maggiore during his first hurried visit to Northern Italy. The terra-cotta on this building is applied so effectively and with such an evident knowledge and appreciation of its character and capabilities, that it, in common with other examples to which reference has been made, might be studied with profit by many of our own architects.

(*To be continued.*)

Fire-proofing Department.

Conducted in the Interest of Building Construction to Prevent Loss by Fire.

FIRE-PROOF FLOOR ARCHES.

BY GEORGE HILL, C. E.

PUBLISHED TESTS.

AUSTRIAN SOCIETY TESTS. — CONTINUED.

WITH regard to the matter of the cost, it may be said that flat arches are always naturally somewhat more expensive than arches built of ordinary bricks; they also require a deeper layer of cinders, concrete, etc., to bring them level with the top of the floor beams, especially where the width between skew-backs requires deep sections. However, the fact of their giving flat ceilings without extra work will make them preferable to brick arches of $\frac{1}{10}$ rise in very many cases.

Medium Spans. Every arch of the second series sprung between I beams with a span of 8 ft. 10.2 ins. was tested to failure, as it was possible to apply eccentric loading here.

Table B gives all necessary data regarding the changes which the arches underwent as each successive load was applied; the horizontal deflections of the crown recorded are, of course, to be taken in the direction of the unloaded segment of the arch.

The arch composed of ordinary bricks in white lime mortar was able to carry a load of 885 lbs. per square foot before it failed, which just about corresponded with the ultimate load assumed; under an eccentric loading of up to 409.6 lbs. per square foot it gave evidence of but very little change. Such arches, therefore, satisfy most requirements put to them in ordinary architectural construction.

The opportunity was here taken to investigate whether or not a shallower arch, say about 3⅞ ins. thick, would answer the same purpose. Inasmuch as bricks of that size are not being manufactured now, an arch was built of "Hönel's" bricks, giving it a rise of 1 : 20, which can be considered great for flat arches. The hoped for result was, however, not attained, as the arch failed under an eccentric load of 491 lbs. per square foot, after having shown considerable deflection beforehand. It does not seem advisable, therefore, to depart from the dimensions which have come to be adopted in practical work, namely: a thickness of 5⅞ ins. and a rise of 1 to 10. The arch of concrete $3\frac{5}{16}$ ins. thick, composition in the ratio of 1 : 4, has fulfilled all requirements, inasmuch as it began to crack appreciably only under

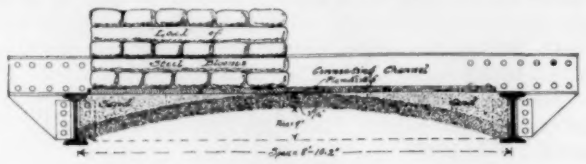


FIG 24- SECTION OF CONCRETE ARCH

a load of 614.4 lbs. and failed under an eccentric load of 1,130 lbs. per square foot. (See Fig. 24.)

The deflections of the crown were uniformly lesser than in the case of either the brick arches or those of corrugated iron.

The two Monier arches deflected, on an average, equally as much as the concrete arches; and, all in all, these two systems do not show any great difference.

The ultimate load for the ideal Monier arch (Fig. 25), using

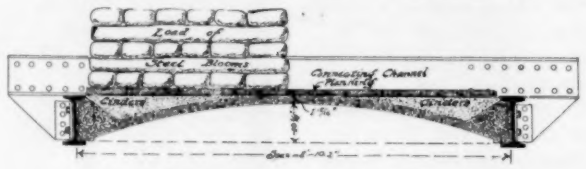


FIG. 25- SECTION OF MONIER ARCH

cinders and planking, was equal to 1,220 lbs. per square foot; for the Monier arch, leveled up with concrete (see Fig. 26), however, 1,320 lbs. per square foot, an increase of 8 per cent. Contrary to this, the ratio of the consumption of concrete in these two cases is 1 : 1.85; so that, from a practical point of view, the second method is in no way superior to the first, as the leveling up with concrete cannot be regarded as an increment of strength, but simply as an equivalent for the layer of cinders, an agent in the distribution of the load.

This assertion can also be proved by pointing to the action of the arch while under load, for as this was successively increased the real body of the arch separated entirely from the superficial layer of concrete, although this had been applied immediately after the arch

TABLE B. ARCHES OF 8 FT. 10.2 INS. SPAN.

Number of load.	Load uniformly distributed on one half of arch, in pounds per square foot.	Movements of the crown in inches downward vertically / laterally.							Remarks and enumerations of ultimate loads.						
		66	67	68	69	70	71	72							
		Concrete arch. Fig. 24.	Monier arch. Plain arch. Fig. 25.	Monier arch. Leveled up with concrete Fig. 26.	Arch built of ordinary bricks.	Arch built of Hönel's bricks.	Corrugated iron. Without reenforcement.	Corrugated iron. With reenforcement of the edges.	Concrete arch.	Monier arch. Arch alone.	Monier arch. Arch with concrete filling.	Arch of ordinary bricks.	Arch of Hönel's bricks.	Corrugated iron. Simple.	Corrugated iron. Reenforced.
1	102.4	0.0433 0.00786	0.0394 0.0118	0.0315 0.00394	0.067 0.01575	0.0552 0.00786	0.1141 0.0197	0.1731 0.0118	Thickness at crown 3⅛ ins., rise 9.05 ins., weight of arch 3,140 lbs., cinders and planking 1,349 lbs. Re 2) horizontal fissure in the unloaded half, re 3) crack at abutment. Failure of the arch under 1,109 lbs. per square foot, one half of arch being loaded.	0.2361 0.0197	0.311 0.0236				
2	204.8	0.0945 0.01575	0.0788 0.0197	0.0708 0.00786	0.197 0.0591	0.366 0.00786									
3	307.2	0.1695 0.0394	0.1575 0.0394	0.130 0.0236	0.335 0.1023	0.721 0.149	0.3462 0.02759	0.382 0.03145	Thickness at crown 2⅝ ins., rise 10¼ ins., weight 5,420 lbs. Re 10) longitudinal crack near crown. Failure of the arch under 1,320 lbs. per square foot, eccentric load.						
4	409.6	0.244 0.0708	0.2361 0.0591	0.193 0.0315	0.513 0.1575	1.439 0.288	0.4419 0.0394	0.461 0.0433							
5	512.0	0.335 0.114	0.335 0.0826	0.279 0.0513	0.767 0.209		0.598 0.0513	0.532 0.063	Thickness at crown 3⅝ ins., rise 9.85 ins., weight 2,680 lbs., cinders and planking 1,500 lbs. Re 7) horizontal fissure over the entire unloaded half. Failure of the arch under 885 lbs. per square foot, eccentric load.						
6	614.4	0.422 0.1575	0.426 0.110	0.374 0.0749	1.083 0.252		0.74 0.0669	0.618 0.0708							
7	716.8	0.532 0.205	0.561 0.134	0.468 0.105	1.472 0.307		0.901 0.866	0.713 0.0826							
8	819.2	0.642 0.252	0.669 0.165	0.555 0.142	2.079 0.394		1.06 0.1181	0.868 0.0905	Thickness at crown 3⅜ ins., rise 9.5 ins., dead weight 1,191 lbs., cinders and planking 1,138 lbs. Re 2) crack in the loaded half, 9.85 ins. from the crown. Failure of the arch under 491 lbs. per square foot, eccentric load.						
9	921.6	0.791 0.311	0.798 0.224	0.708 0.185			? ?	0.968 0.105							
10	1,024.0	0.95 0.378	1.015 0.279	0.863 0.236				1.15 1.18							
11	1,126.4	? ?	? ?	1.049 0.291											
12	1,331.2			1.223 0.346											

itself had been built. By the use of such a leveling up of concrete, it is undoubtedly possible to get along with shallower beams, and generally to decrease the dead-weight; but the strength of the arch is not essentially increased.

Compared with the arches of concrete, the Monier system has

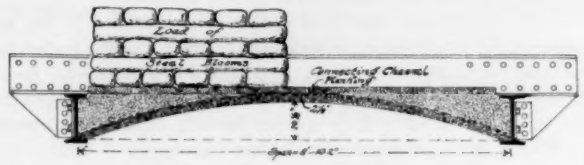


FIG 26 - SECTION OF MONIER ARCH
LEVELED UP WITH CONCRETE

shown only a slightly higher carrying capacity; this difference, from a practical point of view, may be said to be of no consequence.

We may, therefore, conclude from these tests that a slightly thicker arch of concrete is very well adapted for replacing the Monier arch.

In the case of the two spans of corrugated iron (type 3½ ins. by 1.97 ins. by .39 in.), the one was placed directly between the skewbacks, while the other was protected by angle irons (2.3 ins. by 2.3 ins. by $\frac{7}{32}$ in.), which were riveted to its edges to prevent any incidental deformations; the plain piece failed under an eccentric load of 975 lbs. per square foot, while the reenforced sample failed under a similar load of 1,100 lbs. per square foot, so that the ultimate loads were as 1 : 1.13. Assuming these samples to be equivalent to a hinged arch, and calculating accordingly, we find the first to have a fibre strain of 46,200 lbs., and the second 55,000 lbs. per square inch; as this latter amount is quite equivalent to the ultimate strength of soft wrought iron, we are justified in concluding that the reenforcement by means of angles is necessary to make the action that of a hinged arch. As a matter of fact, the corrugated iron so reenforced gave evidence of hardly any deformation whatsoever at the abutments, while, in the case of the plain piece, both the upper and lower arcs of the curved ribs had been very much bent, thereby naturally decreasing the carrying capacity of the arch considerably.

The vertical deflection at the crown was very much greater in both cases than that of either the Monier or the concrete.

TABLE C. DEFORMATIONS OF ARCHES OF A SPAN OF 13 FT. 3.6 INS.

MONIER ARCHES.—FIG. 29–73.

Number of load.	Eccentric load in pounds per square foot.	(v-Vertical.) Recorded Deflections in inches. 1 v	1 h	2 v	2 h	3 v	3 h	4 v	4 h	(h-Horizontal.) 5 v	5 h	Rotation of cross-section (in degrees, minutes, and seconds) at the points: 2	3	4	REMARKS.
1	102.40	+.00394	.00394	+.00788	.0118	0.0236	.0118	.0394	.00788	.00788	.00788	—0′ 15″	—3′ 46″	+2′ 00″	
2	204.80	+.0079	.0079	+.0197	.0236	0.0512	.0236	.0749	.01576	.0118	.0118	—0′ 30″	—7′ 55″	+3′ 54″	
3	307.20	+.01576	.0236	+.0276	.0394	.0984	.0434	.1575	.0276	.0197	.0197	—2′ 00″	—14′ 25″	+7′ 00″	
4	409.60	+.0236	.0394	+.0434	.0788	.153	.0708	.256	.0434	.0315	.0315	—2′ 47″	—23′ 36″	+10′ 44″	
5	512.00	+.0433	.08275	+.0905	.138	.236	.110	.414	.0787	.04725	.04725	+0′ 55″	—42′ 07″	+17′ 00″	
6	614.40	+.0552	.1379	+.138	.181	.326	.153	.563	.118	.0699	.059	+3′ 16″	—50′ 10″	+22′ 27″	
7	716.80	+.0708	.1890	+.1695	.232	.422	.232	.704	.149	.0826	.063	+4′ 09″	—1,014′ 00″	+26′ 48″	
8	822.68	+.1340	3.3900	+.299	.386	.769	.314	1.15	.2615	.124	.067	+7′ 10″	—1,952′ 40″	+43′ 00″	8) 9) after 2½ hours.
9		+.1930	4.5250	+.398	.505	1.08	.386	1.405	.306	.146	.0787				

Thickness at crown 1⅛ ins., rise 15¼ ins., weight 2,215 lbs., cinders and planking 4,160 lbs. Re 4) crack at abutment, re 5) second crack in unloaded half. Failure under 895 lbs. per square foot, re 9) after 2½ hours.

CONCRETE ARCHES.—FIG. 18–73a.

Number of load.	Eccentric load in pounds per square foot.	(v-Vertical.) Recorded Deflections in inches. 1 v	1 h	2 v	2 h	3 v	3 h	4 v	4 h	(h-Horizontal.) 5 v	5 h	Rotation of cross-section (in degrees, minutes, and seconds) at the points. 2	3	4	REMARKS.
1	102.40	+.00394	0.0	+.00394	.00394	.0118	0.0	.0118	0.0	.00394	0.0	—0′ 45″	—0′ 40″	+1′ 00″	
2	204.80	+.0079	0.0	+.0079	.0079	.0276	.00394	.0236	.00394	.0079	.00394	—1′ 35″	—1′ 30″	+2′ 15″	
3	307.20	+.01576	.00394	+.0079	.0197	.0708	.0197	.0943	.0118	.0079	.01575	—3′ 35″	—5′ 50″	+7′ 50″	
4	409.60	+.0197	.0079	+.0118	.04725	.1140	.0394	.1690	.0197	.0118	.0236	—5′ 40″	—10′ 30″	+13′ 40″	
5	512.00	+.0394	.0669	+.00394	.0945	.1695	.0708	.2920	.03914	0197	.0394	—8′ 55″	—14′ 20″	+23′ 45″	
6	614.40	+.0669	.149	—.079	.177	.2130	.138	.532	.0866	.0236	.0631				
7	662.00	+.0787	.197	—.146	.197	.2280	.177	.656	.118	.0276	.0788				

Thickness at crown 3⅛ ins., rise 15¾ ins., weight 4,120 lbs., cinders and planking 4,560 lbs. Re 4) crack — entire length of arch — at abutment. Failure under a load of 812 lbs. per square foot

BRICK ARCHES.—FIG. 28–74.

Number of load.	Eccentric load in pounds per square foot.	(v-Vertical.) Recorded Deflections in inches. 1 v	1 h	2 v	2 h	3 v	3 h	4 v	4 h	(h-Horizontal.) 5 v	5 h	Rotation of cross-section (in degrees, minutes, and seconds) at the points. 2	3	4	REMARKS.
1	102.40	+.0079	.0118	+.1615	.0668	.157	.0512	.258	.056	.0079	.0079	—7′ 00″	—33′ 00″	+10′ 40″	
2	205.5	+.01577	.0236	+.390	.1505	.306	.117	.559	.133	.0118	.0158	—0′ 35″	—1° 12′ 55″	+14′ 35″	
3	274.1														

Thickness 4½ ins., rise 1.379 ins. Crack on the upper surface of one quarter of unloaded arch under 137.5 lbs. per square foot.

MELAN ARCH OF 13 FT. 11 INS. SPAN.—75.

Number of load.	Eccentric load in pounds per square foot.	(v-Vertical.) Recorded Deflections in inches at the points. 5 v	5 h	4 v	4 h	3 v	3 h	2 v	2 h	(h-Horizontal.) 1 v	1 h	REMARKS.
1	102.4	0	.00394	.055	0.0	.0473	0.0	.0236	0.0	0.0	.00394	
2	204.8	0	0.0	.106	0.18	.0944	0.00394	.0434	0.0	0.0	.00394	
3	307.2	0	0.0	.153	0.276	.1419	0.0236	0.0629	0.0197	0.0	.0236	
4	409.6	0	0.0	.2049	0.276	.189	0.0354	0.0709	0.0315	0.0	.0276	
5	0.0	0	—0.055	.0276	0.276	.0157	0.0354	0.0115	0.0118	0.0	.0197	
6	409.6	0	—0.0629	.173	0.866	.1615	0.0747	0.906	0.0433	0.0	.0557	
7	512.0	0	—0.06675	.232	0.906	.212	0.0747	0.1061	0.0512	0.0	.0473	
8	614.4	0	—0.0591	.276	0.945	.252	0.0826	0.118	0.0197	0.0	.0551	
9	819.2	0	—0.0591	4.09	0.134	.406	0.122	0.181	0.0433	0.0	.0866	
10	1024.0	0	—0.0473	5.58	0.1181	.548	0.1459	0.248	0.0708	0.0	.1062	
11	1024.0	0	—0.0748	6.13	0.983	.575	.1141	0.288	0.0394	0.0	.0513	
12	1228.8	0	—0.118	11.29	0.906	.674	.0945	0.319	0 0236	0.0	.0394	
13	1412.0	0	—0.0669	8.23	0.433	.790	.0512	0.382	0.0276	0.0	.0118	
14	0	0		.264	0.0236	.299	.0236	0.209	0.0905	0.0	.0513	

Thickness 3½ ins., rise 11.4 ins., weight, 4,860 lbs., weight of eccentric sand leveling 1,549 lbs.

Re 10) hair crack on under side of arch became visible, about 11.8 ins. long, near crown. This crack did not widen later on.

Re 11) after a pause of 18 hours.

The lateral deflections "h" to the right are recorded as negative.

The vertical deflections "v" are taken with regard to a horizontal connecting the two points of abutment.

In point of cost, the latter two are very much more expensive than corrugated iron of the same carrying capacity, but this requires special treatment in case a ceiling is desired, which would, of course, add to the expense.

The three arches having stationary abutments, with a span of 13 ft. 3.6 ins. (Figs. 18, 28, and 29), had five rods fastened to them,

FIG 27 — ARCH OF 15.83 SPAN SHOWING DEFLECTION POINTS

one at each abutment, one at the crown, and one at one fourth of the span (see Fig. 27), the uprights and triangles belonging to each rod being finally added. At the last-mentioned points delicate levels were adjusted to measure any rotation of the cross-section. Table C contains all the results of these tests. It is evident from them that the carrying capacity of the brick arch was much too small, as tensile strains appeared which the mortar joints were incapable of resisting.

The concrete arch (Fig. 18) failed under an eccentric load of 754 lbs. per square foot; the Monier arch under a similar one of

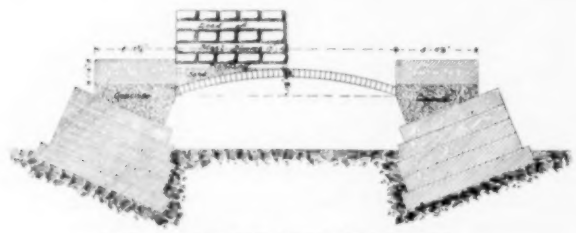


FIG 28 - BRICK ARCH WITH MASONRY ABUTMENTS

893 lbs. per square foot; so that these two arches fulfilled all that was expected of them, showing but a small difference in their respective ultimate loads. The first cracks appeared in both cases under a load of 614.40 lbs. per square foot; the deflections of the Monier arch were somewhat greater than those of the rammed concrete arch.

From these tests, also, it will be seen that the concrete arches compare very favorably in all respects with the Monier system.

After all these tests had been made a new system appeared (the Melan patent), which proposed the reenforcement of concrete arches

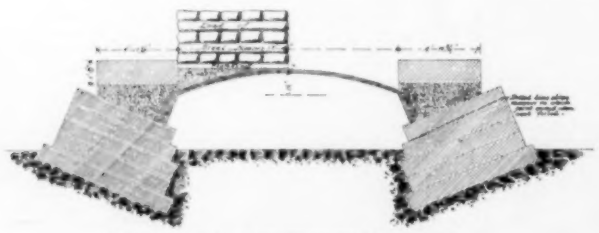


FIG 29 - MONIER ARCH WITH MASONRY ABUTMENTS

by means of curved iron ribs. That is to say, iron I beams, bent truly to the arc of the arch, are inserted at certain fixed distances, corresponding to the static conditions, and wedged — in the case of floors — between the beams.

After the concern manufacturing these arches,— Pittel & Brausewetter,— had made very satisfactory preliminary tests of the same, a sample was built at Brunn, during the month of July, 1892, and submitted to and tested by the committee a year later. This arch had a rise of 3 ft. 3.36 ins.; at a distance of every 3 ft. 3 ins. curved I beams, shape No. 8 (3⅛ ins. high), had been inserted.

The thickness of the arch was 3⅛ ins.; the average composition consisted of one part Radotiner Portland cement to five parts of sand and broken stones. Iron blooms were used as a load, after one half of the arch had received a leveling up of sand.

The vertical and horizontal deflections occasioned by the successive loads, at the crown as well as at the center of the loaded and unloaded segments of the arch, with regard to a horizontal passed through the abutments, are given in Table C; which table shows that this type of arch has a much greater carrying capacity than either the Monier or concrete arches of the same span.

On account of a lack of material, the loading was interrupted after 1,412 lbs. per square foot had been imposed; the permanent changes discovered after the removal of this load being very slight. In the further course of the test an area of 10,763 ft. over the second curved rib was loaded up to 36,200 lbs., at which point failure occurred, the fragments falling in the shape of a cone. Before this dangerous cracks and deflections had appeared under a load of 33,600 lbs.

Because it is evident from the manner of application of the load as just described that the carrying capacity of the curved rib entered more into the resistance than the concrete did, it will not be necessary to record the deflections at this point.

The first method of loading is, however, fully sufficient to characterize this system, because a load of 1,412 lbs. per square foot caused no appreciable deformations.

There can, therefore, be no doubt that this arch is eminently adapted for heavily loaded floors or bridges of small spans.

(*To be continued.*)

FIRE LOSSES FOR SIX MONTHS ENDING JUNE, 1895.

THE following is a comparison of the fire loss in the United States and Canada during June, 1895, with previous periods as made up by the *Journal of Commerce and Commercial Bulletin* from its daily records: —

	1893	1894	1895
January	$17,958,400	$10,568,400	$11,895,600
February	9,919,900	11,297,600	12,360,200
March	16,662,350	9,147,100	14,239,300
April	14,669,900	11,540,000	11,018,150
May	10,427,100	10,777,800	7,761,350
June	16,344,950	8,282,300	9,223,000
Total . . .	$85,982,600	$61,613,200	$66,497,600

These figures, while showing an increase in the loss over 1894, show a most gratifying gain over the same period in 1893, and we do not doubt that fire-proof construction has contributed to this substantial decrease in loss, and yet in what a comparatively small portion of the building being done to-day are the best methods of fire-proof construction employed. A loss of more than $100,000,000 a year by fire is appalling and calls for the most serious consideration of our architects, who in turn should be backed up in their efforts for better construction by property owners and legislators.

FIRE-PROOFING COMPOUND.

A FIRE-PROOFING or fire-resisting mixture has been patented in Europe by a Mr. Debois, which is said to withstand the highest temperature. The material consists of quartz, silica, and sulphate of baryta, the proportions being varied according to circumstances. To this may be added sufficient pulverized puddingstone so that when moistened it has the consistency and plasticity of clay, and can be molded into any desired shape, dried, and burned. — *Brick.*

Mortars and Concrete Department.

Devoted to Advanced Methods of using Cements and Limes in Building Construction.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER V. — *Continued.*

GYPSUM MORTARS.

THE mortar of the great Pyramid of Cheops, as shown by Dr. Wallace, Mr. Cresy, and others, is composed of hydrated sulphate of lime (gypsum), carbonate of lime, and clay.

According to Strabo, the walls of Tyre were built of stone set in gypsum, a very common material, apparently, in Asia Minor and the center of the old Assyrian civilization.

The composition of pure gypsum is as follows:

Sulphuric acid	46.52
Lime	32.55
Water	20.93
Total	100.00

When heated to 230 degs. Fahr. gypsum will part with its water of crystallization. It then becomes sulphate of lime, its composition consisting of sulphuric acid 58.84, lime 41.16 = 100. If then pulverized and mixed with water into a paste, it will quickly harden to a solid mass, becoming crystallized again by recombining with its equivalent of water.

But should the heat be carried above 320 degs. Fahr. it will no longer harden by admixture with water. It will not crystallize. The naturally occurring anhydrite behaves in the same manner when reduced to powder. Although in rock form it has a crystallization, it is very different from that of gypsum.

One part of sulphate of lime will dissolve in 400 parts of water.

One part of slaked lime will dissolve in 760 parts of water.

Silicate of lime, the basis of hydraulic cement, will not dissolve in water.

Sulphate of lime was extensively used by the ancient inhabitants of Mexico, as well as those of Egypt, in their masonry; also for exterior as well as interior plastering, and history bids fair to repeat itself, in some respects, at least, in the use of this material.

In several places in the Western States, and notably in Kansas and Texas, beds of impure gypsum are found of a soft, mudlike consistency. The impurities consist chiefly of clay. Within the past few years some of these deposits have been developed, resulting in the building up of a new industry that bids fair to become quite extensive.

The material is taken from the beds and heated sufficiently to expel the water of crystallization contained in the gypsum, the same operation, of course, expelling the moisture from the clay, upon which the substance falls into an impalpable powder. It is then ready for the market, and is sold for purposes of plastering. It has many advantages over common quicklime for such a purpose, as it sets quickly, becoming dry and hard in a short time. It carries sand largely, quite equaling quicklime in that respect, and, unlike the latter, it requires no hair in plastering.

These gypseous-clay beds were probably a mixture of clay and carbonate of lime, and in the condition of natural hydraulic cement rock. Subsequently, these rocks were subjected to the action of sulphuric acid, which expelled the carbonic acid, and itself combined with the lime, forming gypsum. The presence of the clay, in intimate contact with the gypsum, prevented the latter from hardening, as would have been the case had the gypsum been pure. The sulphuric acid was undoubtedly produced by the oxidation of iron pyrites or by the oxidation of sulphuretted hydrogen from sulphur springs in the neighborhood of the deposits.

The manufacturers of this gypseous-clay cement claim that it sets much harder than ordinary plaster of Paris (calcined gypsum), and attribute to it many features of excellence which cannot be attained by any admixture of pure plaster of Paris and sand.

It is possible that the heated clay may act somewhat in the nature of a pozzuolana, and by reason of its finely comminuted condition, and its intimate contact with the sulphate of lime, effects may be produced that are not possible with a mixture of sulphate of lime and sand.

The Agatite Cement Plaster Company, of Kansas City, Missouri, controls a bed of this material at or near Dillon, Kansas, which is estimated to contain about six million tons.

Prof. Edwin Walters, in a report on this material, says: —

"Agatite is of a light ash-gray color. Its natural consistency is about that of hard plastic clay. When calcined it assumes a pulverized form. When mixed with water it sets as does hydraulic lime or cement. There seems to be ample time between the mixing and the setting for the mortar to be applied to its intended use.

"A sample of several weeks' setting broke under a tensile strain of 370 lbs. to the square inch. It may be safely said that in both tensile and compressive strength agatite is fully one half that of the very best Portland cement under the Neat test and equal under the part sand test. It is superior in strength to most of the hydraulic limes and ordinary cements. But, inasmuch as agatite is intended for interior work, it is not necessary that it should be of such great strength. It is very much stronger than lime and sand plaster, which is its principal competitor.

"Agatite does not differ widely in composition from the cement taken from the famous Cheops Pyramid of Egypt. The Egyptian cement runs higher in sulphate of lime and lower in oxide of iron.

"It is very probable that a cement that would stand in the climate of Egypt would also prove durable in the United States.

"I only make the comparison to show that if the agatite is kept reasonably protected from frosts and excessive moisture that it would last for ages. It has splendid adhesive qualities. It will stick to wood, stone, or brick without the aid of hair or any other substance.

"It is not decomposed by any of the basic acids, however strong they may be. Alkalies do not affect it.

"Besides being a choice material for plastering walls and ceilings, it is admirably adapted to all kinds of interior finish. When in the plastic state it may be embossed, stippled, drawn, or molded. Any design in bas-relief may be executed if prompt action is taken after mixing. The time allowed for execution is much greater than that for stucco, unless the stucco is mixed with glue or some retarder that is likely to cause decomposition.

"Another superiority over stucco is its hardness. Not only does it allow much more time for execution, but it is very much harder after it sets.

"Paper may be applied to either one or two coat work for a finish. It is probable that one coat will be the best method. Paints may be added to agatite mortar to give any desired color, when paper is not desired. If a white finish is wished, a putty or stucco coat may be applied on the surface of the agatite.

"This material is adapted for wainscoting, interior arches, and segments for the back-filling and setting of tiles, for statuettes, etc., etc."

There would seem to be no doubt that gypsum plaster will find an extended use in the near future, and in a measure supplant the use of quicklime as a plastering material in interior work of much importance and magnitude.

It is doubtful, however, if it can ever be used for exterior work in Northern latitudes until some means are discovered for rendering it proof against the action of alternate freezing and thawing.

The climates of Egypt and Mexico are such as to permit the use of this material for exterior work, and there is no doubt but that it could be so used with safety in our Southern States on brick, stone, or wooden structures, and very pleasing architectural effects thereby produced at a comparatively slight cost. Sulphate of lime as a cementing agent has not as yet received the consideration due to its merits in this country. Heretofore it has been extensively used in interior decoration and for similar purposes, but there seems to have been no advance made in the direction of permanent exterior work. It was used as an outside covering of the walls of the World's Fair Buildings at Chicago, which, however, were temporary structures.

By adding 26.47 per cent. of its own weight of water to this material, it becomes so hard and firm that, made into a briquette of one inch square cross section, and given one hour in air and twenty-three hours in water, it will sustain a tensile strain of 250 lbs. before fracture. It can be produced in this country in colors ranging from black to snowy white, and by the admixture of the various shades of sand or clay most pleasing effects may be produced.

There are immense deposits of gypsum in this country, notably in the States of New York, Virginia, Ohio, Michigan, Iowa, Kansas, Arizona, California, Texas, Colorado, and Utah.

The production from the various deposits amounts to about 255,000 tons yearly. Approximately, 63 per cent. of this amount is calcined into plaster of Paris, and 37 per cent. is ground and used as a fertilizer.

The importation of gypsum rock amounts to about 184,000 tons yearly. Could some cheap and effectual process be found to render this material practically frost-proof, its use in exterior ornamentation would rapidly assume immense proportions, and its value as a building material would be almost incalculable.

(*To be continued.*)

THE EDITOR OF THE BRICKBUILDER:

Dear Sir, — In your last issue there was a letter from R. C. S., Jr., in regard to plaster work both with and without half timber.

I have had considerable experience with that sort of work in this country, having first used the material under the specification of an English plasterer who came to this country to make this work a specialty, introducing at the same time selenitic cement.

I have always used three-coat work, the first well-haired mortar and one third Portland cement, added when ready for use; this coat well scratched. The second coat the same, with the omission of the hair, and the third coat the same proportion, but with coarse sand or gravel, either floated or put on slap-dash, according to the kind of finish I wished to obtain.

I have occasionally used a very small quantity of ochre in this last coat, but it must be mixed very thoroughly and carefully in order to produce an even color.

This plaster work I have used on wood lath over stud without rough boarding behind it. Also on rough boarding with furrings and wood lath, which is better; and over rough boarding with furrings and wire lath, which is the best of all.

A small church plastered in this way on wood lath fourteen years ago is in perfect condition to-day, and various houses built during the last ten years have proved perfectly satisfactory. I have not as yet, however, found any method of building true half-timbered-work and making it thoroughly tight without making a wall that was practically as expensive as a brick wall.

I received two years ago from Mr. Peto, late of the firm of Ernest George & Peto, a couple of details showing the method which they used in England when they built real half-timbered-work. The studs were oak rebated to receive plaster or terra-cotta block. The outside plastering was on the face of the blocks, and the inside of the walls was furred so as to leave an air space, and then lathed and plastered. The construction, as you will see, is not a particularly inexpensive one.

Trusting that these few matters of experience may be of use to your correspondent, I am, Very truly yours, R. C. S.

THE ABUSE OF CEMENT.

FROM A PAPER READ BEFORE THE CANADIAN SOCIETY OF ENGINEERS.

BY D. B. BUTLER.

THE treatment which cement sometimes has to undergo at the hands of inexperienced users makes it a matter for wonder that failures are not more frequent. One of the most prolific causes of failure is insufficient attention to the setting properties of the cement under treatment. In very hot weather it is no uncommon thing for a cement to have a very quick initial set, and in using such a cement, therefore, in order to obtain its full strength, it must be mixed and in its allotted position within a very few minutes of adding the water. This often entails the mixing of very small quantities at a time, and, if due precautions are not taken, a larger quantity is mixed than can be manipulated before setting commences. This generally results in the use of additional water and the serious detriment, if not total destruction, of the setting properties of the cement. Many cases of failure have occurred in which the cement being a good quality, though somewhat quick setting, point strongly to over-manipulation or "killing."

Another frequent cause of unsatisfactory work is a dirty and unsuitable aggregate. The admixture of a very small proportion of dirt or loam is quite sufficient to materially deteriorate the strength of a concrete, and too much stress cannot be laid upon the necessity for seeing that all aggregates are free from any foreign dirty matter. A case of structural failure came under the notice of the author a short time back, in which the cement used was perfectly good, but the finer portions of the aggregate consisted of very fine sand, so fine that 60 per cent. passed through a sieve having 70 holes per lineal inch, and 80 per cent. through a sieve having 50 holes per lineal inch. The structure of which it formed part had to bear a considerable thrust, and to aggravate matters, instead of this sand being properly mixed, large patches occurred in which there was no cement at all. In addition to this, the sand contained a considerable portion of loam or foreign matter, and it is not to be wondered at that failure resulted.

The neglect of the proper cooling or aeration of a cement is a frequent cause of trouble, and, to ensure satisfactory work, proper cooling cannot be too strongly insisted upon. Of course cement may give good results when used hot from the mill, and the author has manufactured cement which has turned out satisfactorily under these conditions, but to use cement in this state is to court failure. It is sometimes specified that the manufacturer shall store the cement in his warehouse at a stated thickness of, say, three feet, for a certain period, and have it turned over three or four times at regular intervals before being supplied for use, but if this had to be done with the entire output of every factory, it would necessitate an enormous increase in warehouse room, to cover the first cost of which would entail a largely increased price to the consumer. It is, therefore, advisable, where cement is being used in considerable quantities, to construct temporary cooling sheds, with a good, dry, boarded floor, where the cement can be turned out in sacks or barrels and thoroughly aerated before use. It is sometimes contended that the cement, even if shipped hot, cools sufficiently during transit. Although it undoubtedly cools to a certain extent, it is doubtful if, when tightly packed in barrels, or closely stowed in sacks, it cools sufficiently to allow of its being immediately used with safety.

The exposure to extremes of temperature has, perhaps, more to answer for in the shape of unsatisfactory work than is generally recognized. If exposed to a summer sun immediately after being gauged, naturally a great deal of the necessary moisture is evaporated, leaving the cement without sufficient to complete the crystallization already set up. The result frequently is that the work crumbles and shows signs of failure. On the other hand, exposure to frost acts on the water, and by expansion destroys the surrounding concrete. The author once had occasion to investigate a case of failure in which frost was the undoubted cause of the mischief, as there was no fault

to be found either with the cement, aggregate, or manner of manipulation. The concrete flooring of an outhouse in some new farm buildings was commenced late in December, and left partly completed, owing to the Christmas holiday. As frost set in with unusual severity during the interval, the work was not revisited until the return of milder weather, three or four weeks afterwards, when it was found that that portion which was laid immediately before the frost was utterly destroyed, while the proportion previously laid, which had sufficiently hardened to prevent total destruction, showed signs of flaking on the top where it had been floated or trowelled. In this case the cement had to bear the blame, although the destroyed portions, afterwards relaid with the same materials, gave perfectly satisfactory results. During severe weather, therefore, proper precautions should be taken to protect freshly laid concrete from the effects of frost.

To summarize the preceding remarks, the chief points requiring attention in the use of cement, in order to obtain the best results, are the following: (1) Sound, well-ground cement, of steadily increasing strength. (2) Due attention to the setting properties of the cement. (3) Clean, well-proportioned aggregate. (4) Proper maturing of the cement before use. (5) Protection from extremes of temperature. If these points always received the amount of attention due to their importance, failures in cement work, apart from defective design, would very rarely be heard of. — *Canadian Architect.*

EDITOR OF THE BRICKBUILDER:

Dear Sir, — The inquiry of R. C. S., Jr., in the July number, as to the best method of constructing stucco, mastic, etc., for half-timbered-work, brings to mind the fact that there is a wide field in a method of dwelling-house architecture which has long been neglected.

It is doubtful if there is any scheme of decoration which combines economy of cost with good practical results better than the old-fashioned half-timbered-work. It is almost what one might call a lost art, for it requires skill, and intelligence, and a good knowledge of materials to make a success of it.

There was some of this class of work done recently in this vicinity, and it consisted of three coats put onto wire lath. The final coat was a skim of half and half cement, with the result that in the course of a very short time the whole surface could be removed with a shovel. The work is, nevertheless, simple in character, and requires only a knowledge of the material and some experience in local conditions. The ordinary wire lath of a number of varieties is stretched between the wooden studs; this is plastered thoroughly with lime mortar mixed with a little Portland cement and a small amount of hair. This should be allowed to harden, the surface being well roughed. Upon this the outer coat of slap-dash should be thrown, the surface being first well wet. This coat may be composed of half cement and half coarse plasterer's sand, colored if desired; or of cement, sand, and fine stone or coarse pebbles to secure the rough effect desired. There should be no lime used in this outer coat, and the cement should be the best Portland. The sand should be coarse and sharp, and if from a beach should be well washed to get the salt out. Otherwise, there will be danger of the white efflorescence which is injurious to the appearance of the wall. A good effect may be secured by building a coarse-surfaced concrete wall and then plastering it with a mixture of one of cement to two or three of coarse sand,— the honeycombing of the concrete furnishing the best of keys. The mortar should be put on with a float and then rubbed down with a big wad of cloth to secure uniformity of surface. The board marks on a concrete wall may be in a large measure avoided by using good stock and beveling one edge of each board, so that when the boards swell from being wet the sharp edge of the beveled board will be jammed against the square edge of the adjoining board and thereby make a tight joint. This is a method much used by Mr. E. L. Ransome in his concrete walls. Great care should be taken to have the work done in the summer or spring, so that it may be well dried out and seasoned before the frosts come, for if there be moisture remaining in the work there is likely to be trouble. If this work is properly done there is no end to the field nor to the variety of its uses. It will last for scores of years in any climate, and may be seen in great quantities to-day in Canada, and all over Europe, and many parts of the States. R. F. T.

HOW TO PREPARE MORTAR.

A RECENT number of *Engineering* contains an article by Edward Wolff, showing the proper as well as the defective methods of making mortar. Mr. Wolff says: —

"The slacking operation should be done in a water-tight box made of boards, and so much water should be mixed in that the contents will never get dry, and a sheet of water will remain on top to prevent access of air. If the box will not hold the entire quantity of lime required, the contents may be emptied into a cavity made in the ground close to the pan, and this process may be repeated. This should be done at least two weeks before sand is added, or before the mortar is prepared for use. Slackened lime prepared and kept as stated has been found free of carbonic acid after many years, air and gas not having been able to find access. Instead of following the procedure in slacking lime recommended above, we see in this country, or, at least, in the neighborhood of New York, a faulty process adopted, which consists in loosely mixing the sand with the slacking lime immediately after water has been added, and forming a dry heap on the surface of the ground, which is left lying there several weeks to give time for complete slacking before the sand is worked in evenly and the mortar considered ready for use. This heap arrangement is perfectly adapted to circulating air through a material which should be guarded against contact with air. The sun heats the surface of it, makes the air escape after it has given up its share of carbonic acid gas, while at the base of the heap and at the shady side a fresh supply enters to fill up the vacuum after it has circulated through the heap and has been robbed of its share of carbonic acid gas. That this procedure really happens in such a heap we can easily see when we place a lump of freshly slacked lime in a wineglass, and in another glass place a small quantity of material taken from a heap such as described, and which has been prepared a few days before; fill both glasses nearly up with water, and add a few drops of muriatic or sulphuric acid to each. In the first glass nothing can be observed, while in the second glass we will see in the shape of small bubbles the carbonic acid escape, which has been absorbed by the lime from the atmospheric air circulating in the heap."

A NUMBER of experiments on the adhesion of cement to brickwork have been carried out by Messrs. L. J. Affelder and R. C. Brown. Both natural and Portland cements were experimented with, several brands of the latter being tried. Three varieties of brick were used in the experiment, viz., a hard red brick having a specific gravity of 2.136, and absorbing 4.56 per cent. of water; a soft red brick having a specific gravity of 1.981, and absorbing 8.81 per cent. of water; and a firebrick having a specific gravity of 2.000, and absorbing 5.17 per cent. of water. The cemented surfaces of the bricks were 2¼ ins. square, and the joints were about ¼ in. thick. The results showed no definite relation between the adhesive and cohesive properties of the cements, but the general conclusion arrived at was that with Portland cement the adhesive power was at least one fifth of the cohesion, when new, and that in time it would have been fully equal to it. — *British Clay-worker.*

THE WAYLAND PORTLAND CEMENT COMPANY, Wayland, Steuben County, N. Y., has been incorporated by Valentine F. Whitmore, John N. Rauber, William Vicinus, of Rochester, and Jacob B. Whitemand, of Wayland, to work quarries and to manufacture Portland cement. Capital stock, $100,000.

The Mason Contractors' Department.

Conducted in the Interests of the Builder and the Contractor for Brickwork.

CRACKS IN BRICKWORK AND PLASTERING.

WHAT CAUSES THEM, AND HOW THEY MAY BE PREVENTED.

BY A. H. DYER.

IT is a noticeable fact that many brick buildings of moderate size and cost are planned and built in a manner that would indicate that the architects, as well as the builders thereof, place little or no significance in the fact that all cracks that occur in building construction have a well-defined cause, and can therefore be prevented if proper precaution is used, and that, too, without materially increasing the cost of the building. As before stated, they all come from well-defined causes; therefore, there is nothing mysterious about them; consequently they ought to receive practical, matter-of-fact treatment, entirely free from useless formulas or intricate mathematical problems, neither of which will be found necessary in any of the following examples, but it will require a thorough knowledge of materials and plain common sense, added to long-continued practise and close observance of results, to become what might properly be termed "an expert."

The author does not claim to have discovered anything new in the art of building, but believes that some of the most important things already known should be more fully understood and practised.

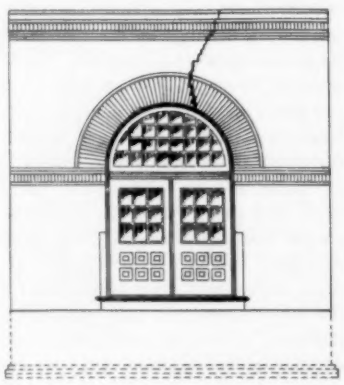


FIG. 1.

Take, for an example, the end wall of a small one-story warehouse, as shown in Fig. 1, and notice the irregular crack through and above the arch. Should we inquire the cause of this defect, it is safe to presume that the general answer would be, "Foundation not heavy enough." As no one seems to know the exact dimensions of the foundation, or why or where it is not of sufficient proportions, it will be necessary to dig down to the footings and also get the dimensions of the wall before we can make a practical investigation. The dimensions of the wall are found to be as shown in Fig. 2, the wall being 12 ins. thick, the bottom footings 20 ins. in width, and the soil beneath them to be a thick bed of coarse dry sand. The center girder is supported by an independent pier, and the ends of the floor and roof joists rest upon the side walls. Taking the height of the wall between one of the corners and the jamb of the opening, and figuring the brickwork at 112 lbs. per cubic foot, we find the weight of the 12 in. wall, including the offsets of the footings, to be 2,621 lbs. per lineal foot; therefore, the load at this point will be about 1,573 lbs. upon each square foot of bottom footings. As this kind of soil can be safely loaded with twice that amount per square foot, it would not in this case appear to be overloaded. Upon further examination, we find that the brickwork below the center of the opening gives a load of only 346½ lbs. per square foot, or less than one fourth the load between the opening and one of the corners. It is true the weight directly above the opening is equally distributed upon each jamb of the opening, but in a foundation of this depth and an opening of this area the load below the center of the opening will not be increased to any great extent by the weight above the opening. It is very evident that in case of any settlement of the foundation that portion under the center of the opening would not settle to as great an extent as would the foundation at each side of the opening, which has more than four times as much load per square foot. This would cause the soil below to be compressed to a convex plane, or, in other words, the quoins or corners of the building would be thrust outward at the top and away from the opening, and the continued strain would cause a crack similar to that shown in Fig. 1, always beginning at the nearest weak point of brickwork on the side most affected by the unequal settlement, or on both sides simultaneously, as the case may be. In a semicircular arch this weak point would naturally be where the joints begin to assume a nearly perpendicular line. The brickwork being bonded together, the entire width of the building above the arch prevents the crack starting at the top of the wall, which would undoubtedly be the case if there were no opening, provided that the foundation settled to the same extent and in the same manner.

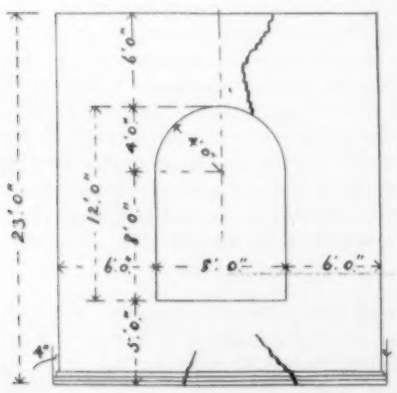


FIG. 2.

Having proven without a doubt that the crack was not caused by an overloaded foundation, also that it could not be caused by a uniform settlement, we must therefore admit that it was caused by unequal settlement. As it would be impracticable as well as quite expensive to attempt to insure a brick building against any settlement whatever, we must devise some method by which the settlement, if any, shall be equal and uniform throughout the entire area of the footings. This is somewhat difficult to accomplish where the soil is not uniform, but in this case we have a uniform bed of coarse, dry sand.

Some authorities have claimed that the only way to insure an equal settlement of a foundation was to build an inverted arch below each opening, or tier of openings, and that the inverted arch should be either semicircular or parabolic.

While it may be admitted that an inverted arch may prove beneficial in some cases, it must be remembered that a great deal of harm may come from them if used promiscuously, and under no conditions whatever should they be used near the quoins of a building, as the result may be still more disastrous than that caused by a continuous footing without them.

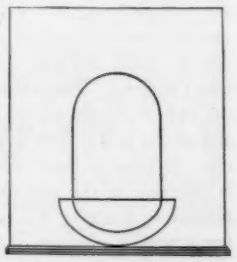


FIG. 3.

In the case of Fig. 3 there is one important reason why the inverted arch will not give the desired result; the width of footings under the arch and below the opening is the same as between the opening and the corners of the building; or, in other words, we have a continuous footing of uniform width the same as shown in Fig. 1.

The inverted arch does not lessen the load at the corners; neither does it create and distribute a load of five tons below the opening to compensate the weight of five tons of brickwork which has actually been removed from the center of the wall. If the wall were solid, or without any openings whatever above the footings, and of a uniform thickness and height, each square foot of footings would sup-

port a uniform weight; but if we remove a weight of five tons from the center of the wall, as in Fig. 3, and do not diminish the area of footings accordingly, the load per square foot cannot by any means be equally divided.

The inverted arch does not weigh any more per cubic foot than the other brickwork, and, although it may have a tendency to distribute the weight farther toward the center line, it cannot in the case of Fig. 3 place a weight of 1,573 lbs. upon each and every square foot of footings below the opening, *because it lacks just five tons of being heavy enough.*

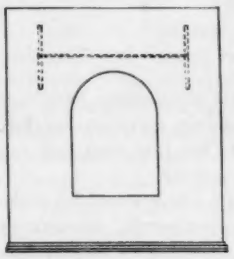


FIG. 4.

Fig. 4 shows another method of treating an opening like that shown in Fig. 1. The writer has known of several instances where a ⅞ or 1 in. iron rod, and I beam anchors from 6 to 8 ft. long, were designed and specified to be built into the wall just above the opening, and as shown in Fig. 4. This might perhaps prevent a total collapse of the wall, or it might cause the crack to appear at the outside line of the anchors instead of in the arch, but we fail to see how it in any way affects the footings. It would be almost impossible to build these anchors and the rod in the center of a 12 in. wall and have the rod of sufficient tension to prevent a crack in case of unequal settlement, like Fig. 1; and, besides, it would be necessary to cut out the center of the wall to such an extent as to weaken the bond of the brickwork just where the most strength would be required. This method is as impracticable as it is useless. With the 6 ft. of brickwork at each side of the opening, the semicircular arch and the brickwork above, it is amply able to care for itself if built upon a perfect foundation. The anchors and tie are in this case a bungling attempt to hide the effect, without removing or modifying the cause. There are cases where a tie-rod would serve to prevent "buckling," but this is not one of them. A cotton string, with a lath nail tied to each end and laid in the joints, would be much better so far as removing the cause of cracks is concerned, for it would not weaken the brickwork.

Fig. 5 shows another method which is more practical than either Fig. 3 or Fig. 4, and is sometimes used in shallow foundations with very good results, but it is not always to be relied upon.

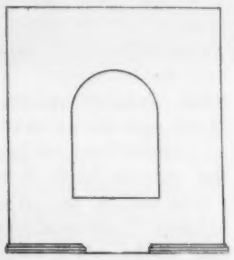


FIG. 5.

Fig. 6 shows a practical way of proportioning the foundation of a wall, as shown in Fig. 1 and Fig. 2.

The wall is divided into three sections or panels, A, B, C.

We will place the width of the footings at 20 ins., the thickness of the wall above the footings at 12 ins., and the weight per cubic foot at 112 lbs. A weighs 15,736 lbs., which gives a load of about 1,573 lbs. per square foot. C is the same as A; a weight of 9,986 lbs., or, approximately, five tons have been removed from panel B. In order to have a perfect foundation, we must reduce the area of footings in B, so that the load per square foot will be approximately the same as in A and C, and in no case should it be less, but in Fig. 1 it is less than one fourth as much. By adding together the weights of the different sections in B, as marked on the elevation (in cubic feet), we find that it will be necessary to "cut out" 4 lin. ft., or 6⅔ sq. ft. of the footings below the center of the opening. In order to support the brickwork above the "cut out," we will turn a segment arch, as shown in the bottom section of Fig. 6. The opening below this arch takes out approximately 4 cu. ft., which we will deduct from 43⅓ cu. ft., as shown above, for in this case we are making no allowance whatever for any weights above, except the brickwork, in order that we may more thoroughly demonstrate the principle of a uniform footing, and, moreover, the extra weight of frame, doors, and transom upon B would be desirable, as this panel should be loaded a very little heavier than the outside ones, so that the compression of the ground beneath would have a tendency to be *very slightly* concave, instead of convex. Upon further examination we find that the footings inside of the jamb lines and upon each side of the "cut out" cover an area of 3⅓ sq. ft., or a total of 6⅔ sq. ft., more than is required to support A or C.

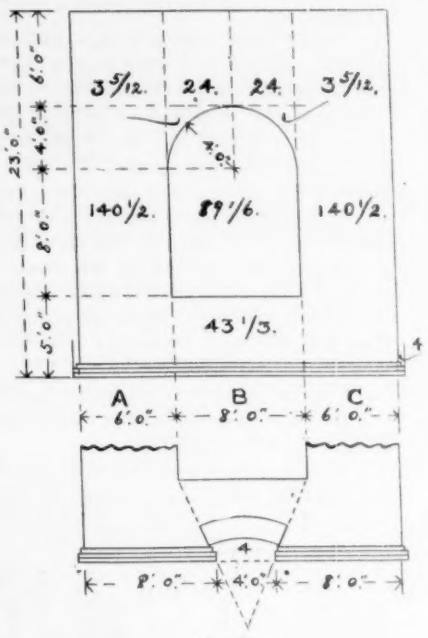


FIG. 6.

Taking out the contents of the opening and "cut out," we have a total weight in B of 94⅙ cu. ft., or 10,546 lbs., divided by 6⅔ sq. ft. of footings would be approximately 1,581 lbs. per square foot, or 8 lbs. more per square foot than the load upon A or C, the difference of 8 lbs. being on the safe side, as recommended above. Now, to prove that we have made no errors, we will divide the net weight of the entire wall, which is 375⅙ cu. ft., or 42,018 lbs., by the net area of footings, which is 26⅔ sq. ft., and we have an average load of about 1,575 lbs. per square foot, or 2 lbs. per square foot more than the actual load of A and C, or a total excess of about 52 lbs. The extra load of 8 lbs. per foot in B, for the 6⅔ sq. ft., would also amount to 52 lbs., which proves that we have made no serious error in our calculations.

It will be noticed that in figuring the area of footings we did not take into account the 4 in. projection at each end; by Fig. 7 it will be seen that by separating the side wall (with its proper share of footings) from the end wall, and removing A to B, the end wall will have its proper share of footings and no more; this fact should also be remembered when calculating the area of footings. We have now fully demonstrated the fact that the crack, as shown in Fig. 1, was not caused by an insufficient area of footings. We have entirely removed exactly one fifth of the original footing and now have a foundation that has practically a uniform load for each square foot of footings, and furthermore we have in this case a foundation that is sufficient to support twice the amount of weight, provided all other footings of the building are proportioned in a like manner. If *a hole* 10 ft. sq. in a 12 in. brick wall weighs *as much as 100 cu. ft. of brickwork it will need just as much footing below it as if the wall were solid; if it does not weigh as much as the solid wall it does not require as much footing.*

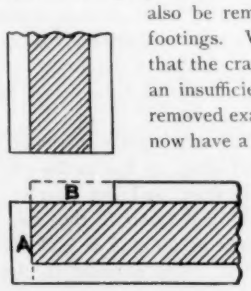


FIG. 7.

If it is necessary to close up the opening under the segment arch, an 8 in. or, in most cases, even a 4 in. wall may be built in the opening, but the center of same should conform with the center of the main wall, and should have no footings whatever, and filling in should not be done until walls are completed and have had time to settle, and should be done in a manner not to interfere with the settling of the main wall.

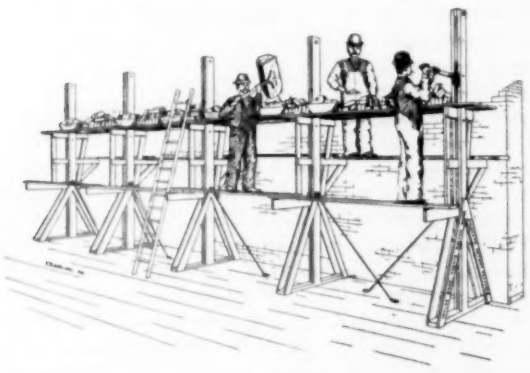
ONE of the most important advances in contractors' machinery that has come to our notice is an inside scaffold from which to lay brick, lately put upon the market by a Boston mason, named Gilbreth.

Nearly every contractor has had his experience with patent scaffolds, and has, after using them a short time, discarded them for the old trestle horses. This scaffold, on the contrary, seems to have come to stay, as those who are using it agree with the inventor that it actually saves from 25 to 40 per cent. in labor in laying brick.

The scaffold itself consists of a horse which supports a sliding frame, which in turn carries platforms at three different levels, — *i. e.*, on the top rest the planks for the brick and mortar; on the side toward the wall the masons' planks are located a distance down below the stock platform that enables the mason to pick up materials with the least effort and without stooping; on the side away from the wall the tenders' platform is located at a distance below the stock platform that they may deposit the stock without climbing any higher than is absolutely necessary.

This arrangement of the platforms enables the workmen to do with the same effort nearly twice the amount of work that they could on the old-fashioned scaffolds.

A simple and ingenious pulling jack has been devised to lift the platforms, — supporting frames and stock without stopping the



workmen. This jack consists of only four pieces, — a case, a rack-bar, the lower end of which is hook shaped, a ratchet handle, and a gravity pawl.

In order to lift the scaffold, the jack is hooked onto a pin which is passed through the uprights of the horse. The lower end of the rack-bar hooks into the hanger of the frame. A few strokes of the handle raises the frame eight inches, and it is supported by a pin which passes through a hole under the top member of the frame.

One jack only is required for a large number of horses, as it is light and easily carried from one horse to another.

This scaffold is especially adapted to walls built "overhand," as the mason can back up the wall the full width as fast as the wall is built. This is particularly desirable in frosty and wet weather; and every mason knows that bricks can be laid faster in this manner than when the further or overhand side of the wall is built up thin, staging high, and is then backed up. The demand on the tenders for stock is more uniform, which is also an advantage.

The success this staging has met is due, in part, to its extreme simplicity. It takes no longer to set it up than to set up any other, and when once in place the wall can be built without interruption or delay the whole height necessary for the next floor beams, which is very desirable where rapidity of construction is required.

When the horses are not in use they take up very little room, — in fact, less room than trestle horses.

One of the most important features of this scaffold is that it is all in one piece, and any unskilled laborer can set it up after having once seen it in operation. No staging lumber is wasted.

At the last exhibition of the Massachusetts Mechanic Association this scaffold was awarded a silver medal.

Recent Brick and Terra-Cotta Work in American Cities.

A Department Devoted to the Interests of the Manufacturer.

CHICAGO. While Chicago real estate transactions have been very slow lately, the volume of building operations for July has been good,— nearly doubling the record for July, 1894, and surpassing any month since the World's Fair activity.

"A friend of mine rented a small, six-room, steam-heated flat on the South Side the other day, for thirteen dollars per month." Remarks of a similar kind are frequently heard, showing that rents are considerably depressed. But, notwithstanding the commonly talked of over-supply, the building of apartments goes on at an astonishing rate. Much of it is due to improved transportation facilities, the new electric and elevated roads having made available much new territory. Many cheap buildings are being erected in the outlying districts. A good part of the present building activity, however, is in the line of nice residences for wealthy and well-to-do people.

Pile foundations are now going in for two more large buildings, — one, the new Studebaker office and warehouse building on Wabash Avenue, S. S. Beaman, architect; the other, the eighteen-story Fischer Building, D. H. Burnham & Co., architects. No wood enters into the construction of these foundations except the piles themselves. A heavy layer of concrete covers the heads of the piles, and this in turn supports two tiers of steel beams filled solid with concrete. The cast stools are then bedded on cement mortar, the bed varying from ½ in. to nearly 2 ins. in thickness under different stools. The chief difficulty in using piles in Chicago has been the almost disastrous results to adjoining buildings from the driving. In the above-mentioned instances the adjoining buildings are small and easily taken care of.

Another new office building will begin construction soon on Dearborn, south from Van Buren Street. It is 50 by 60 ft. in plan, and twelve stories high, but, like the Atwood, it will be built for the addition of three more stories as soon as the 130 ft. limit ordinance is repealed. The front of this building will be buff brick, white joints, with trimmings of white glazed terra-cotta. Jenney & Mundie are the architects.

Ground has been broken for the temporary post-office, and now the question (likely to be answered before this goes to press) is, "Who will be the architect for the new permanent government building?" As usual, those working hardest for the appointment are least worthy, and it would not be surprising if politics should rule and another boodle building scandal be added to the list.

A certain large apartment building in Chicago, destined by its owner to be the finest of its kind, has had serious troubles in the way of defective foundations, which settled disastrously and threatened to throw out the front. Lately, while the building was still unfinished, the owner met a tragic death by falling from the roof.

One of the most sensational items of news among architects lately has been the retirement of Mr. Dankmar Adler, who leaves the practise of his profession to take charge of the sales department of an elevator company. The news came in the way of a shock. It is safe, perhaps, on general principles, to predict that a successful veteran like Mr. Adler will not stay out of architectural harness very long.

The death of Richard M. Hunt has brought eulogies from all directions. Chicago has had a special claim on Mr. Hunt since the World's Fair, and feels a personal loss in his death. So strong were his personal qualities that architects who had not even met him feel now as if a friendship were broken.

DETROIT. Business in building circles has shown a decided improvement the past week over any similar period in a long time, and builders are greatly encouraged.

Among the sales are a number of lots in the better portions of the city, upon which new buildings are to be erected forthwith. The same encouraging state of affairs extends to the architects, nearly all of whom are busy on work that is to be done at the earliest possible period.

Indeed, the situation is such that the actual demands of the growing city are forcing business both with the architects and real estate men. The idea is firmly established that prices have reached their lowest point and that buildings will never again be erected for the figures now taken upon them. Two magnificent new buildings are announced for erection this week, and the prospect is that the coming month will be the best for building this year.

Traugatt Schmidt will immediately begin the erection of a substantial business block on the site of the one recently occupied by Keenan & Jahn, which was destroyed by fire. The matter has only been delayed thus far for lack of a suitable tenant. The other day a fifteen years' lease of the new building was signed by L. N. Valpey; and Donaldson & Meir, the architects, have been directed to proceed with the execution of the plans in compliance with Mr. Valpey's suggestions with all possible despatch. The new structure will be 60 ft. by 100 ft. and eight stories in height, costing about $60,000.

Another architectural ornament is soon to be added to the many handsome buildings of Detroit. August C. McGraw has had plans drawn and will soon begin the erection of a magnificent apartment house on the north side of Jefferson Avenue, to cost $70,000. The plans are by Spier & Rohns, and contain the result of wide research on the part of Mr. McGraw, whose purpose is to make the apartments superior to anything of the kind in Detroit. The building will be 54 ft. by 88 ft., six stories in height, and constructed of pressed brick with terra-cotta trimmings.

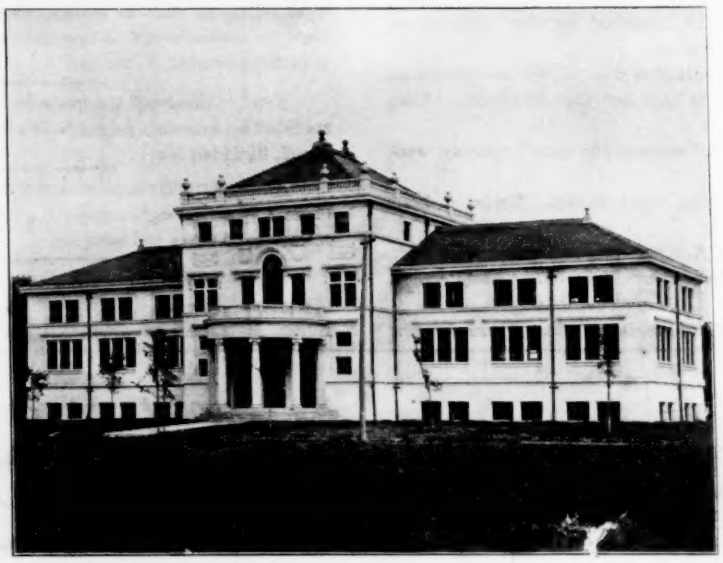
The design submitted by Architects Mason & Rice was adopted by the commissioners of the fire department and will be used for three new engine houses, costing $20,000 each.

The same architects have prepared plans for a brick stable for the Park, to cost $35,000. The Park and Boulevard commissioners have been considering the plans and perfecting the specifications during the past week and on Friday next will receive proposals for its erection.

A Detroit architect has completed plans for a brick store building to be erected on the triangular corner of Congress Street, Cadillac Square, and Randolph Street, for Dr. S. G. Miner. Building will have 100 ft. frontage, and will be built of pressed buff brick, five stories high, costing $100,000.

Architect Joseph E. Mills has prepared plans which have been duly adopted for a new brick church edifice for St. Johns German Evangelical Lutheran Society. The work of construction will be commenced at once.

The subscribers to the fund for the Woman's Building have decided not to wait until the entire amount of $60,000 is raised, but to go ahead with what they have, on the plan of the Chamber of Commerce. They are now figuring on a site for the building.



ORRINGTON LUNT LIBRARY, NORTHWESTERN UNIVERSITY, EVANSTON, ILL.
W. A. Otis, Architect, Chicago.

ROCHESTER building, though comparatively quiet this year, seems to be slowly increasing. Messrs. Fay & Dryer are having plans figured for a three-story store building to be built for Sleight & Brownell, on Lyell Avenue (New York Hydraulic-Press Brick); cost about $8,000.

Geo. F. Hutchison has just let contract to John C. Geminder for the erection of a new district school at Irondequoit, N. Y., for $7,000.

Mr. J. G. Cutler, the well-known manufacturer of the mail chute, is erecting an office building on the corner of East Main Street and Belmont Park, which for the present will be two stories high, but when complete will be six stories, and will run through to East Avenue; New York Hydraulic-Press Brick Company's old gold brick.

Kelly & Headley have let contracts for the erection of a Roman Catholic Church at Clifton Springs, N. Y. It will be built of New York Hydraulic-Press Brick and cost $15,000.

Messrs. Walker & Briggs have plans ready for figuring for additions and alterations to Western New York Institute for Deaf Mutes, cost about $10,000; and Armory Building for the Second Division Naval Reserve at Charlotte, N. Y.

Chas. F. Crandall has just let contract to Henry Oberlies for the erection of additions to the almshouse for $6,625.

ORRINGTON LUNT LIBRARY.

THIS building was given to the Northwestern University by Mr. Orrington Lunt, of Chicago. The architect is W. A. Otis, of Chicago, who has a well-established reputation, not only as a practitioner, but also as a lecturer in his profession in several educational institutions in the West, and is an advocate, not only of good designing but of the use of first-class materials in a field where as yet price too often cuts the greatest figure, and worth and adaptability are regarded as of secondary importance to cost.

This building shows a design in the best style of colonial work. The walls are of dressed Ohio sandstone and the roof and roof trimmings of tile and terra-cotta from the works of the Celadon Terra-Cotta Company, Charles T. Harris, lessee, at Alfred, N. Y. The tile are of red color and are laid in alternate sizes of 4 in. and 8 in. "Conosera" design, which gives to a low roof a lighter and livelier effect than the 8 in. by 12 in. tile alone would in mass. The finial and ridge give a finish and completeness to the whole roof that is very satisfactory. The same combination of tiles was used by Architect S. S. Beaman on the Pullman Memorial Church at Albion, N. Y., last season, with a result that has been highly commended by all who have seen it. For higher roofs and larger buildings the larger tile in mass is to be preferred. The Celadon Company are now making this shape of tile in sizes of 10 by 15 ins., 8 by 12 ins., 6 by 12 ins., 4 by 12 ins., 3 by 12 ins., and 2 by 12 ins. With these combinations,

not only can any possible tower or curved surface be perfectly fitted, but light and shadow effects can be obtained possibly with no other tile made.

BUFFALO. — The activity in building has not increased during the past month, outside of those at present erecting and a few school competitions.

The real estate outlook is brighter. Plenty of money can be had upon A 1 investments.

Depew, our suburb, received quite a boom lately, but now seems to be going more conservatively.

The high school competition has been decided in favor of Beebe & Sons. Cost, $175,000.

The large buildings are now assuming shape. The Guarantee Building has reached its fourteen stories, with terra-cotta up six stories. The architects are Adler & Sullivan, Chicago. The terra-cotta was furnished by Northwestern Terra-Cotta Company.

The Endicott Square Building will be ten stories high, and occupy one whole block, while sides will be 203 ft. and 240 ft. respectively. Burnham & Company are the architects. Cost, $2,500,000. The brick and terra-cotta will be furnished by the Perth-Amboy Terra-Cotta Company. Otis elevators.

Realty Building has its foundations set. It will be ten stories, iron construction. Green & Wicks are the architects. Cost, $250,000.

The following is a mention of some of the more important work now being done: —

The Moody-Brisbain Building, eight stories. Beebe & Sons architects; Sayre & Fisher brick.

W. O. Chapin Building, E. A. Kent architect, four stories high, cream brick; terra-cotta furnished by New York Architectural Terra-Cotta Company.

Rumsey Building, George Cary architect. Cost, $50,000. The terra-cotta was furnished by the Northwestern Terra-Cotta Company. It is white, glazed, and gives people the impression of white marble; quite striking.

La Salle Flats, F. H. Loverin architect. Cost, $75,000.

The Laird Flats, Strong & Wilby architects; 100 by 100 ft.; absolutely fire-proof. Cost, $200,000.

The Carmichael Flats, George J. Metzger architect. Eighteen suites of rooms. Cost, $75,000. Sayre & Fisher brick.

WITH the coming of high buildings has arisen an imperative demand for better elevator facilities, and the manufacturer of elevator machinery has been called upon to exert himself to keep pace with this demand. It would now seem that the electric elevator is in a fair way to become a very formidable rival to the belt, steam, or hydraulic lifts.

Mr. Wyman, of the Moore & Wyman Machine Works, South Boston, states that they have an ever-increasing demand for the electric elevators, both to replace old style machines taken out, as well as for new buildings, and that the electric elevator is constantly growing in popularity from the many advantages peculiarly its own, among them being its ease in manipulation, its automatic safety arrangement, its minimum cost in operation, and its obtainment of a perfectly smooth movement of the car.

THE "Conosera" tile made by the Celadon Company has been specified by Architect Angus S. Wade for the roof of the new Walton Hotel, Philadelphia.

ARCHITECT DUBOIS CARPENTER has opened an office at 242 Church Street, Poughkeepsie, N. Y., where he would be pleased to receive catalogues and samples.

THE ATWOOD FAIENCE COMPANY, of Hartford, Conn., have opened an office in the Institute of Building Arts, Chicago. Mr. Burton Hills has been appointed general manager.

HERE IS ONE

Representation of a FIREPLACE MANTEL. Our Sketch Book, containing 39 others, will be sent you on application.

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PHILA. & BOSTON FACE BRICK CO.,

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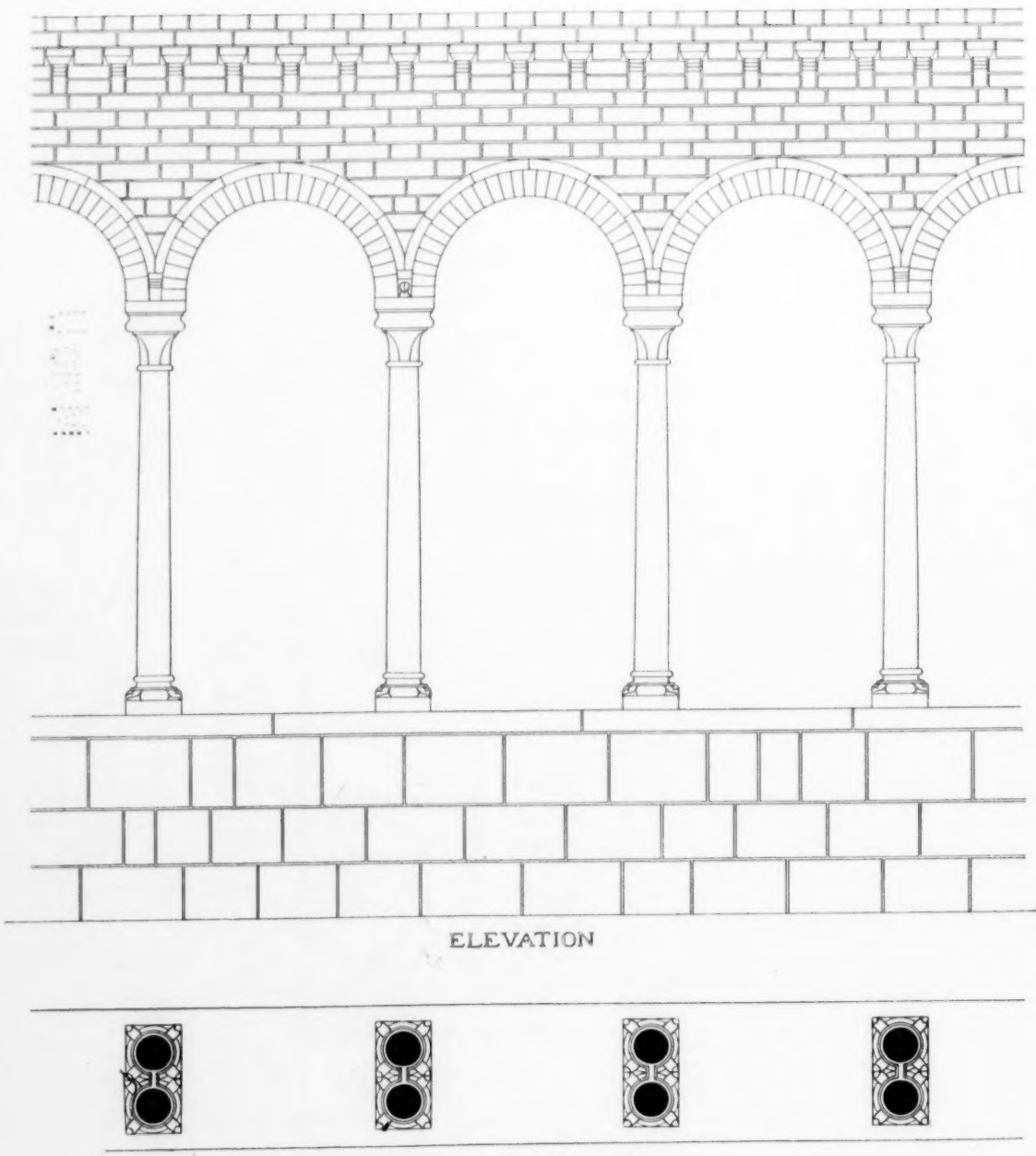
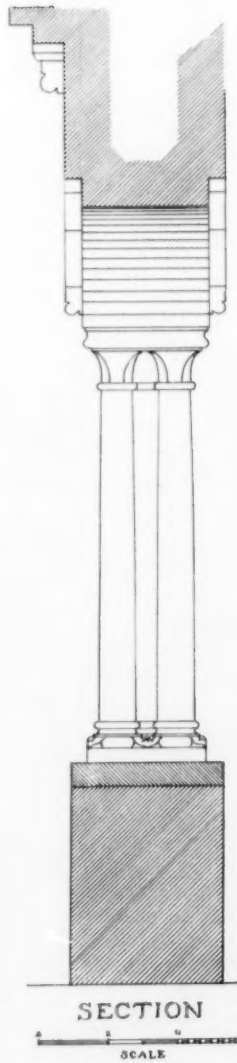


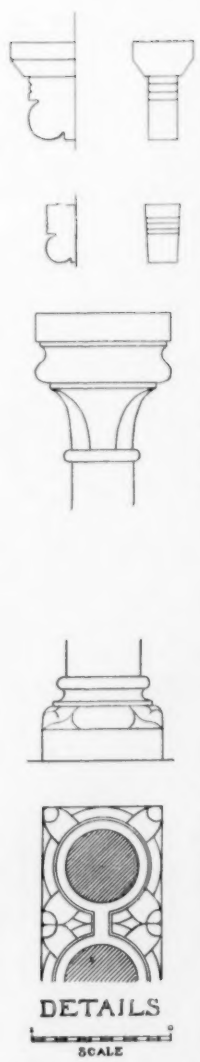
ELEVATION

PLAN



SECTION

SCALE

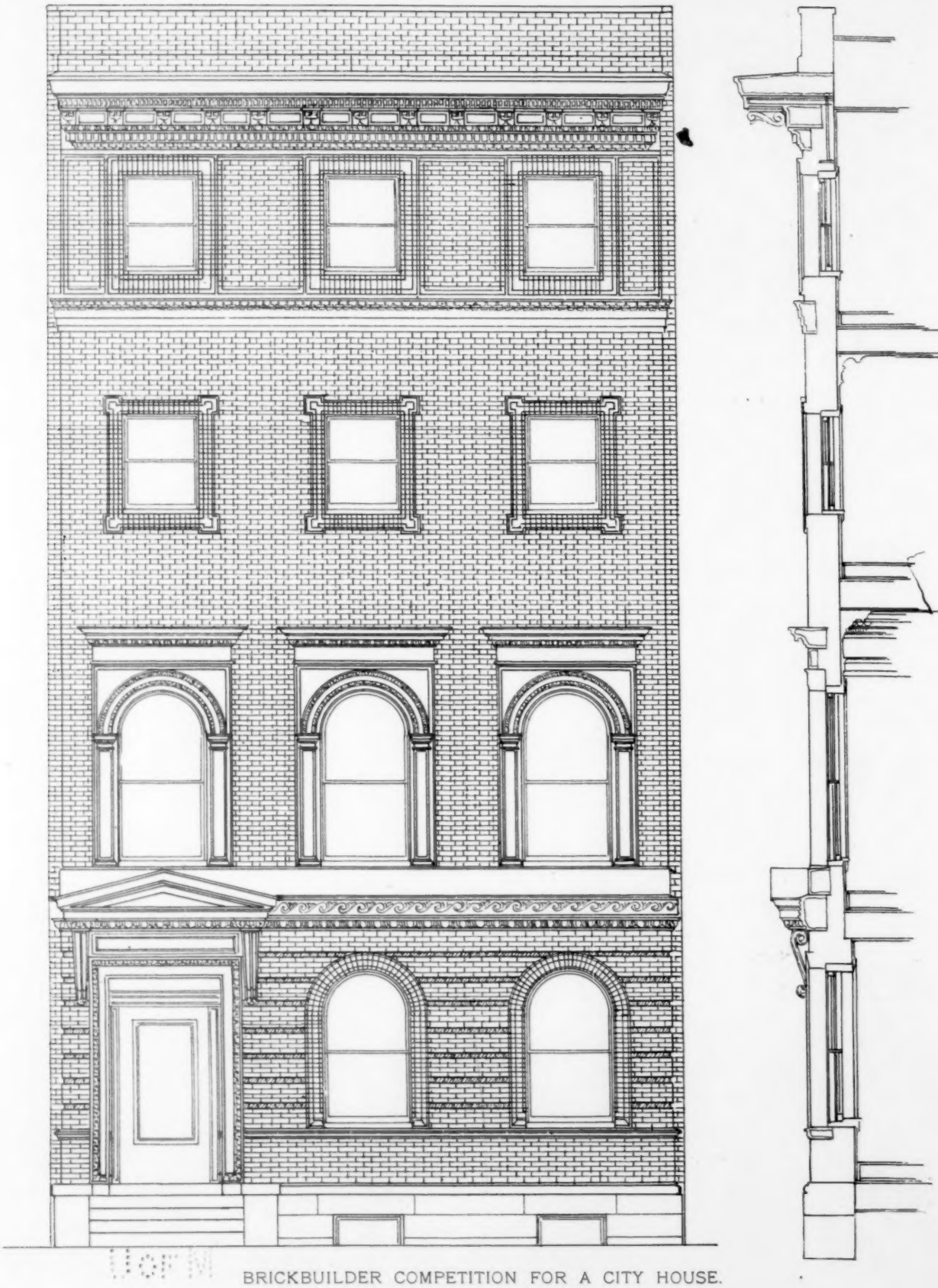


DETAILS

SCALE

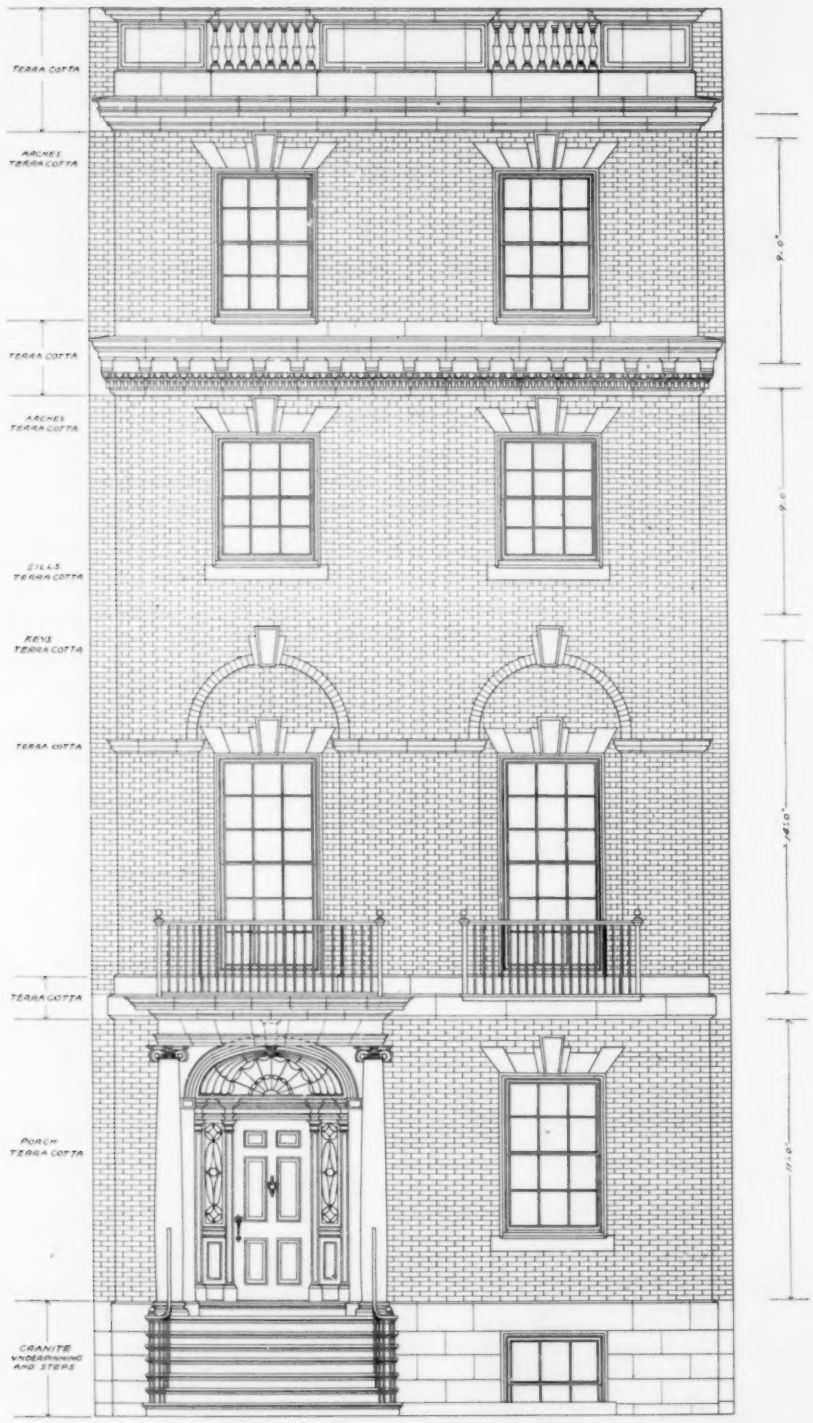
NOTE. Columns Red Marble.
Brick in Voussoirs Bright Red
laid with thin Joints.

MEASURED DRAWING OF THE ARCADE ON NORTH AND SOUTH SIDES OF CLOISTER, SAN ZENONE, VERONA.



BRICKBUILDER COMPETITION FOR A CITY HOUSE.

SPECIAL MENTION. WILL S. ALDRICH. BOSTON.

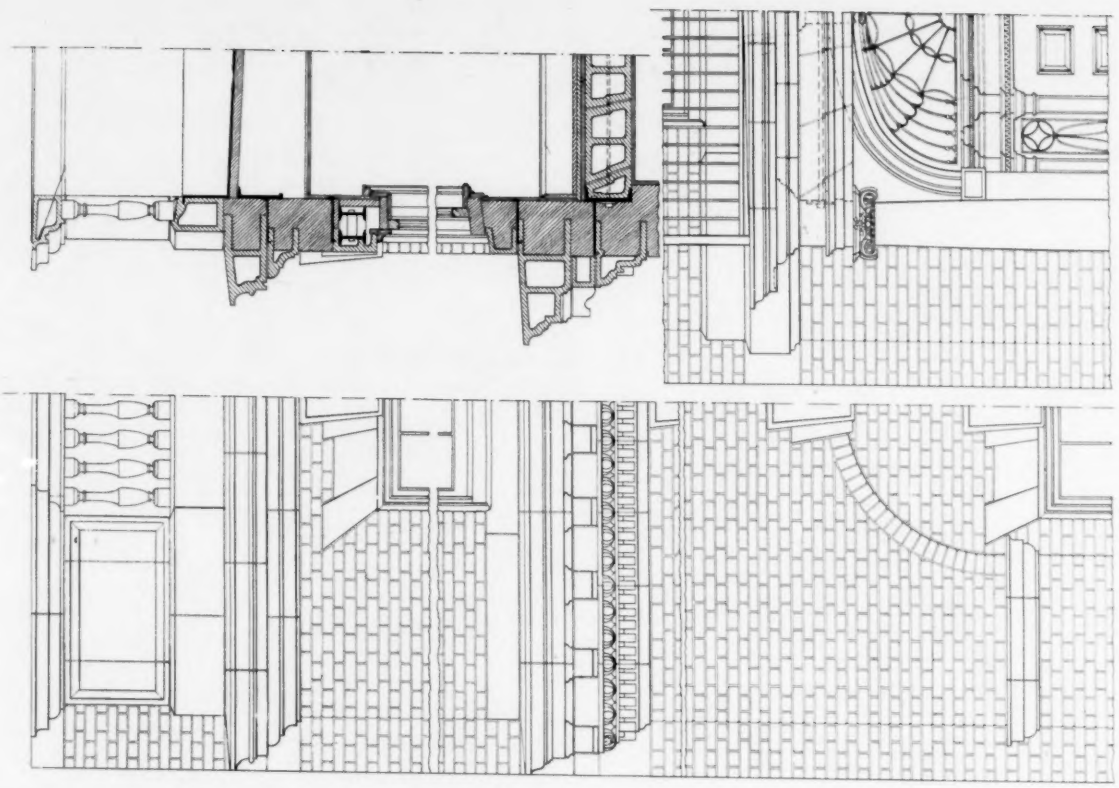


ELEVATION

SCALE 1" 5' 10'

BRICKBUILDER COMPETITION FOR A CITY HOUSE.

FIRST PRIZE. EDWIN R. CLARK. LOWELL. MASS.



DETAILS

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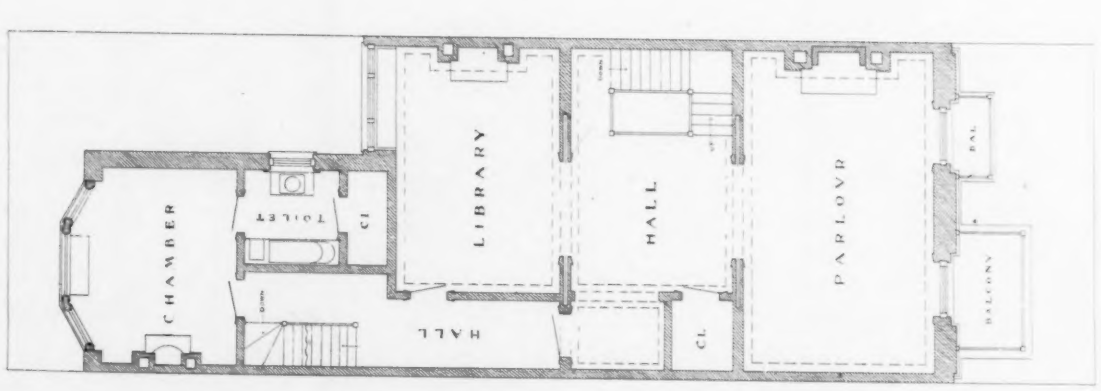
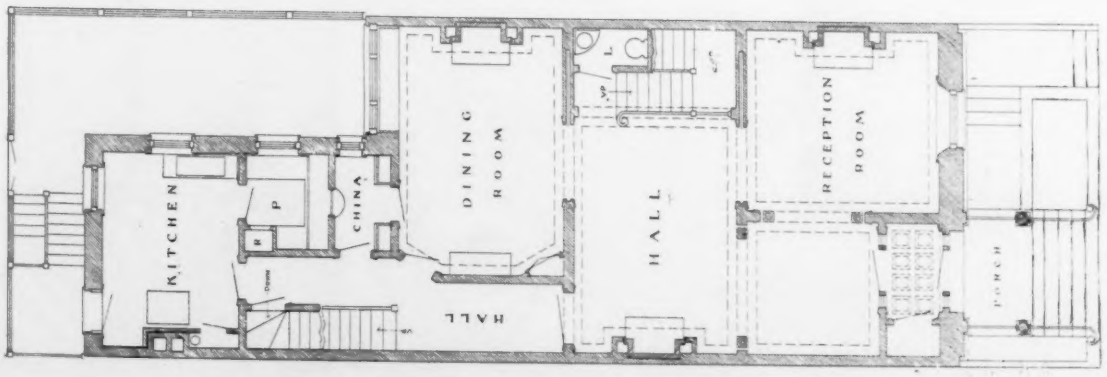
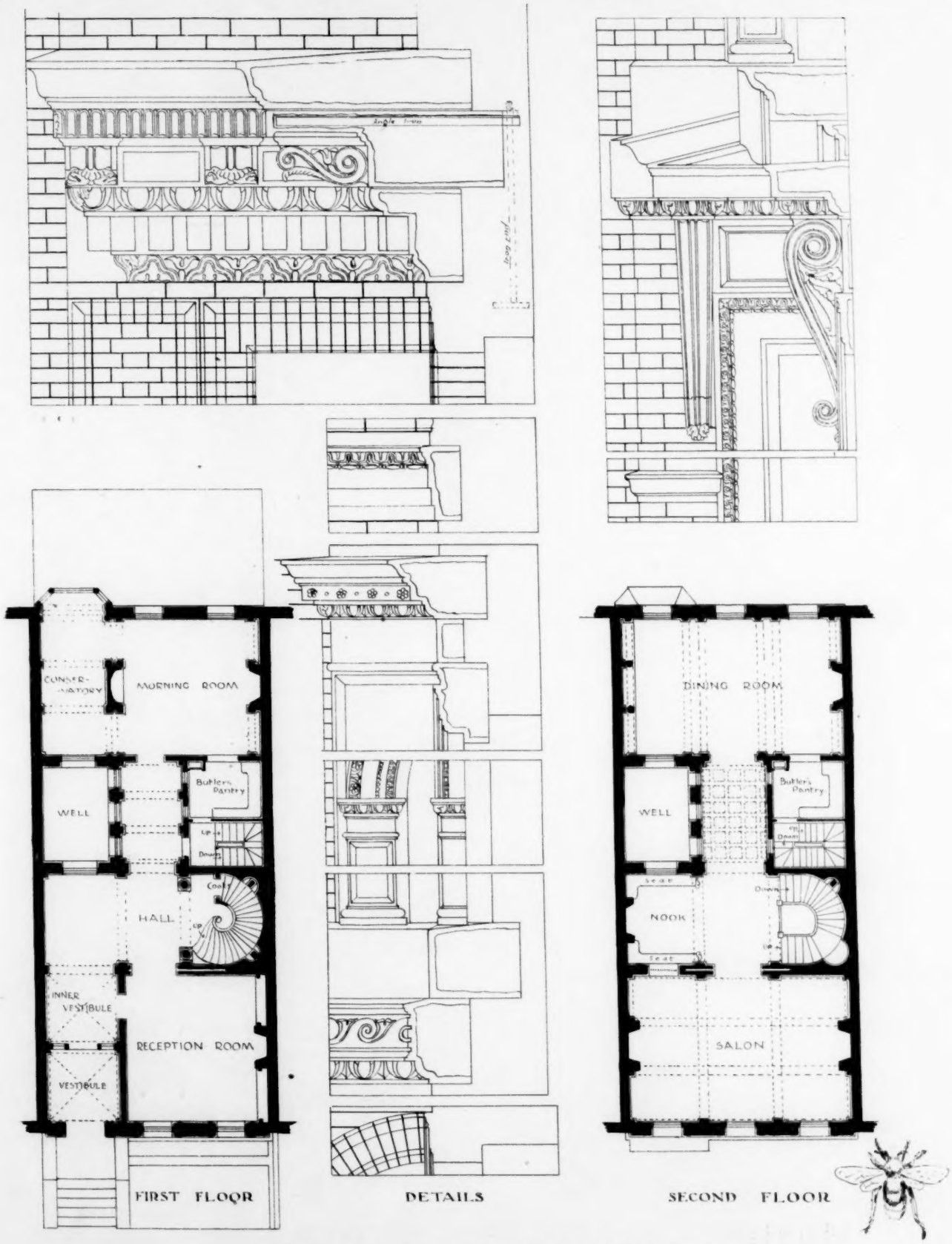


SECOND FLOOR



FIRST FLOOR

SCALE



BRICKBUILDER COMPETITION FOR A CITY HOUSE.

SPECIAL MENTION. WILL S. ALDRICH. BOSTON.

THE AMSTERDAM GATE, HARLEM, HOLLAND.

C. J. BROOKE, DEL., PHILADELPHIA.